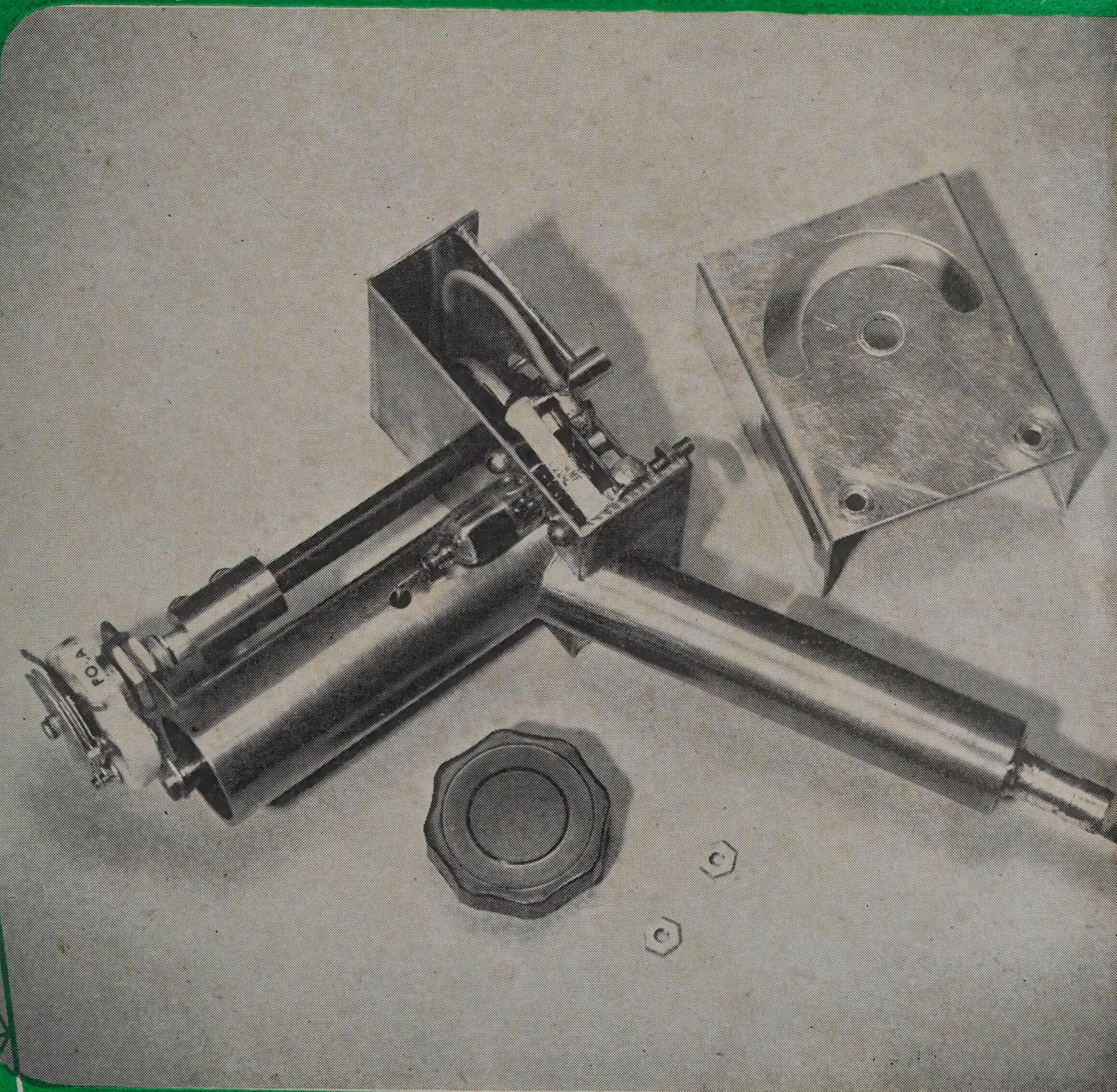
RADIO and ELECTRONICS

ELECTRICITY — COMMUNICATIONS — SERVICE — SOUND



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RADIO AND ELECTRONICS

Vol. 7, No. 5 1st July, 1952

OUR COVER

This month's cover illustrates the "plumbers' delight" co-axial wavemeter described in this issue on Page 7.

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The First T.V. Transmission In New Zealand

Since our last issue went to press, news has been published of the first "real" television transmissions to have been successfully undertaken in this country. Mr. B. T. Withers, and a team of engineering students have succeeded in transmitting pictures, together with their accompanying sound, over a distance of several miles in Christchurch.

As a technical achievement, it might be said that this news is not of great importance. Any competent electronic engineer, given the necessary special equipment and some funds, should in these enlightened times have been able to design and supervise the construction of such a project, and we are sure that Mr. Withers himself will agree that this is so, but we would not like readers to gain the impression that this journal would attempt to minimize the merit of the achievement. Far from it. It is, however, inevitable that technical people should take a somewhat different view of such an event from that of the general public, who can hardly help regarding TV as something not very far removed from wizardry! Our own view, indeed, is that the greatest importance of the Canterbury College Engineering School's project is not merely that it is the first recorded instance of the construction and operation in this country of a modern high-definition TV system. This is certainly a fact of which Mr. Withers and his associates can well and justifiably be proud, but of infinitely more vaule to the Engineering School and the participating students is the practical realism that it must have given a course which could otherwise be little more than one of reading from text-books. The necessity for adequate practical training to back up even the best of theoretical instruction, tends to become forgotten, especially when the provision of facilities for practical training costs a good deal of money. It is a safe bet that those students who were fortunate enough to have a hand in the television project have found their interest and understanding immeasurably enhanced by the nice balance between theory and practice that a design problem of that magnitude necessitates. Mr. Withers is to be congratulated on his foresight and enthusiasm in using this most modern, and at the same time most comprehensive means of bringing home to his students the full implication of their theoretical studies in electronics.

B.B.C. Call Broadcasting Conference

The Director of Broadcasting, Mr. W. Yates, and the Chief Engineer of the New Zealand Broadcasting Service, Mr. W. L. Harrison, recently left for London, there to attend a conference of Commonwealth broadcasting authorities. All members of the Commonwealth are to be represented, but the agenda is still confidential, as, presumably it will be until the conference actually takes place. It is rumoured, however, that television is to figure prominently, and should this be so, it would hardly be surprising. It has always seemed a pity that in spite of the leadership of Britain in this field, none of her Dominions should yet have seen fit to institute television services. In the United Kingdom, it is true that the television service is run at a loss. That is to say, the sums received from television licence fees do not cover the capital and running costs by any means. But it is noteworthy that in spite of this, and in spite of the financial difficulties that Britain has found herself in for several years, she has only recently, when in the gravest of financial difficulties, reduced the rate at which the vast television expansion programme is being carried out. This fact should be significant. Canada and New Zealand, for example, are in a much better position financially than is Great Britain, and could well afford to do something about providing television services. International prestige is a peculiar thing, and seems to depend largely on a number of more or less imponderable effects, among which, things like the full utilization of modern technical resources in ways like this seems to be one. It may well be that the B.B.C. wants to encourage other members of the Commonwealth to do something about TV, because as things stand at the moment, the world at large could hardly be blamed for thinking that America leads the television field. In point of exploitation of world markets for TV equipment, it can truthfully enough be said that she does. While we know that even American television broadcasters are making use of British transmitting and camera equipment, it is not likely that other countries are aware of British leadership in this aspect of TV technique. There is little doubt that TV development inside the Commonwealth itself would give a tremendous boost to Britain's prestige in electronic matters, and would both directly and indirectly help to increase the volume of the British electronic industry.

Converting the R1155 Communications Receiver

On the surplus market recently have been a considerable number of ex-R.A.F. communications receivers, known officially as R1155, and unofficially as the "Marconi jeep receiver." The latter name arises from the fact that these sets were standard equipment in heavy bombers during the last war. Because of this, these receivers are provided with facilities that are not needed for purely communications purposes. As well as covering the range of 75 kc/sec. to 18 mc/sec. (with a small gap to accommodate the I.F.) they are provided with arrangements for enabling them to be used with a loop aerial as a direction-finding set. The circuits concerned with this part of their job can quite easily be either left in the set, and ignored, or else taken out to make room for a small power supply.

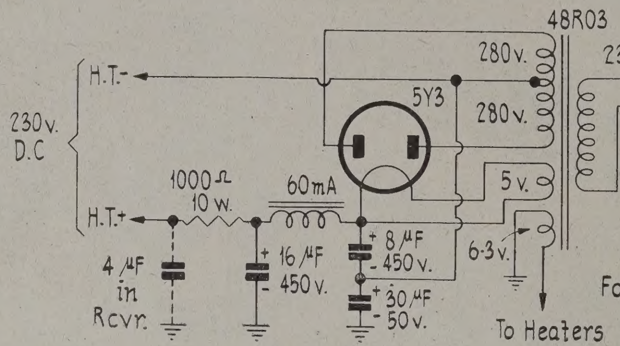
VERY LITTLE CONVERSION

The title of this article is a little misleading, in that unless one wishes, there is no need to do any conversion work at all. Getting them going under these conditions is simply a matter of attaching 6.3 volts for the heaters of the valves, and 230 volts at 60 ma. for the H.T., to the appropriate pins of a socket on the front. We do not intend to describe this in detail, because as far as we know, all these sets are sold with a sheet, reprinted from the *Wireless World,* which published the necessary information in July, 1946. If any owners of sets have not got this reprint, they should be able to obtain access to a copy of the original publication at their local public library. The purpose of this article is rather to give detailed instructions on how to take out some of the unused gear inside, to enable a power supply to be built in. Before we get on to this, however, a brief description of the set may be useful to those who have not already purchased one.

DESCRIPTION OF THE SET

Basically, it is a six-valve circuit comprising a tuned R.F. stage, an oscillator-mixer, two I.F. stages combined second detector, A.V.C., and audio amplifier, and a B.F.O. There is also a magic-eye tuning indicator tube.

Output is at headphone level only, from the secondary of a transformer in the plate circuit of the double-diode triode. The remaining three valves are all concerned with the D/F function, and may be removed from their sockets without affecting the operation of the set proper. The frequency range is quoted above, and is noteworthy in that it includes all but the extreme low-frequency end of the broadcast band. The I.F. is 560 kc/sec., and so there is a gap in the general coverage between 500 and 600 kc/sec. It says something for the selectivity of the I.F. channel that when an aerial is connected to the grid of the mixer valve there is no trace of 2YA in the output, in spite of the small difference of 10 kc/sec between it and the I.F.



Power Supply For R1155A Receiver

Circuit Position	Service Number	Type	Osram Type No.	Near Equivalent
R.F. Amp.	VR100	R.F. Pentode	KTW63	6U7G or EF39
I.F. Amp. (2)	VR100	R.F. Pentode	KTW63	6U7G or EF39
Oscillator-Mixer	VR99	Triode-Hexode	X65	X61M or ECH35
Detector, A.F. Amp.	VR101	D.D. Triode	DL63	EBC33 or 6Q7
A.V.C. and B.F.O.	VR101	D.D. Triode	DL63	EBC33 or 6Q7
Tuning Indicator	VI103	Magic Eye	Y61	6U5G or EM34

Note: (1) The EBC33 is a much closer match for the DL63 than the 6Q7.
(2) Both X61M and ECH35 have much higher conversion conductances than the X65.

VALVE TYPES

All the valves are octal-based, and of quite ordinary characteristics, so that even if valve replacements cannot be obtained, it will be a simple matter to find near-equivalents that simply plug in, with only minor circuit alterations, if any. Incidentally, two of the three D/F valves are of the same type as the oscillator-mixer triode-hexode, and so can be kept as spares. The table above gives a list of the Service numbers, which will be found marked on the valves, and their direct commercial equivalents, which are Osram valves. A third column suggests suitable replacements, should these be needed.

PERFORMING THE CONVERSION

Having given a general idea of the set, we will proceed to detail the steps to be taken in removing the unwanted parts of the circuit without spoiling the working of the main part of the set.

(1) Remove the VR102, which is the centre tube on the left of the B.F.O. shield box.

(2) Remove the two VR99s at the extreme right of the chassis, and keep as spares for the oscillator-mixer stage. Remove the grid leads for these two tubes. Remove the right-hand rear valve socket.

(3) Remove the two large R.F. chokes mounted on the coil box directly behind the power plugs.

(4) Note and tag the heater, B+, B—, and output leads to the power plugs. Then remove the plugs. All other leads may be cut or removed.

(5) Remove the insulated plate on the end of the coil box. Two red leads come out of the end of the coil box. These are from the aerial wafer on the main band switch, inside the box. Take the cover off the coil box and remove these two leads from the wafer switch, noting the lugs from which they come. The one of these lugs which is nearest the back of the chassis is then connected through a 15 $\mu\mu$f. condenser to the lug which is connected to the aerial trimmer for Range 1. From the same lug, there will be found a lead running through the front of the coil box and then up to the 5-position switch on the front panel directly above the power plugs. Put an extra length of wire on this lead. This wire is later connected to the aerial terminal that is to be fitted.

(6) There are two B+ leads, one from the magic eye, and one feeding the reeciver tubes. This latter runs through a channel along the bottom edge of the front panel. Both these leads should be connected to the unearthed terminal of the large 4 μf. block-type condenser. The leads may need extending in order to reach this point. All other leads connected with the D.F. circuits may now be removed.

(7) Mount three insulated solder-lugs under the right-hand front corner of the chassis. Connect the B— lead to one, and the two heater leads to the others. Mount a two-lug strip on the end of the coil box and take a lead from B— to one of them. The other is used as a terminal for the choke, the 16 μf. condenser, and the 1000-ohm resistor on the accompanying power supply diagram. Another two-terminal strip is mounted near the rear of the coil box as a termination for the 230-volt power lead.

(8) A small choke, 50 to 60 ma., is mounted over the right-hand rear socket hole, from which the socket was removed (see (2)). The other socket, which was not removed, will be used for the rectifier valve.

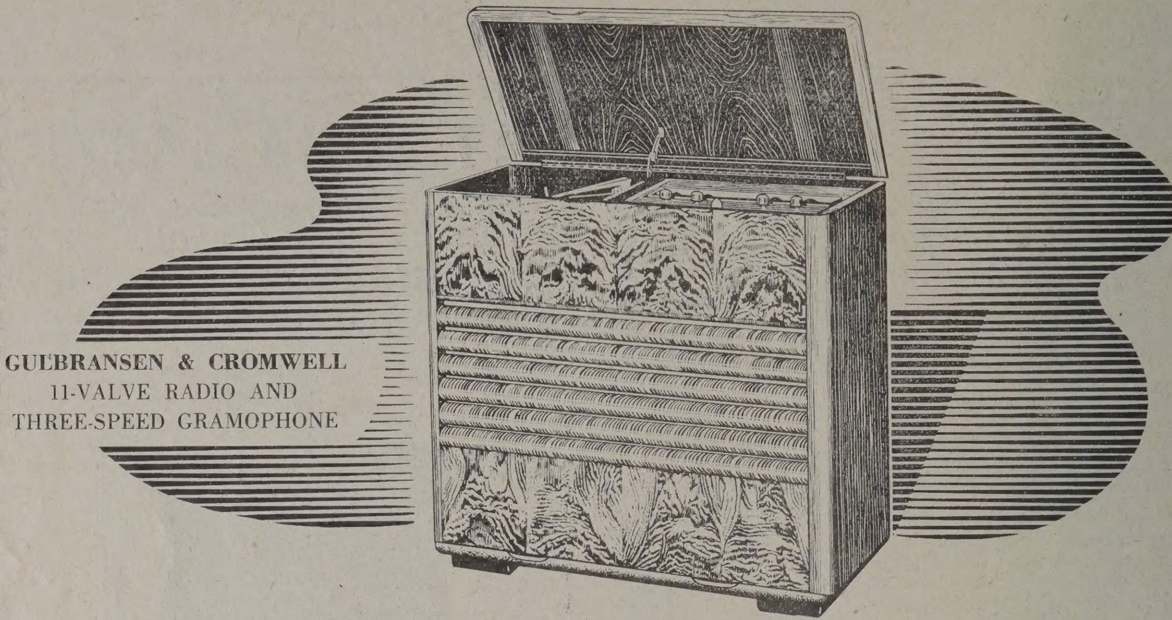
(9) Mount the 60 ma. power transformer on its side in the cleared space between the panel and the coil box. To fit the transformer, two brackets are made from aluminium. One fits under the mounting bolts of the 4 μf. condenser, and the other fits to the bar running right across the end of the chassis. Keep the transformer as close as possible to the coil box.

(10) Cover the hole in the front panel left by the power plugs with a plate of sheet aluminium, on which has been mounted a 'phone jack and an aerial terminal. Plenty of room will be found at the right-hand of the chassis for the electrolytic condensers, the 1000-ohm wire-wound resistor, etcetera. Complete the job by connecting the audio output lead to the 'phone jack, and the aerial lead, previously added to the 5-position switch, to the aerial terminal.

Notes: (a) The bracket on which the large R.F. chokes were mounted may be removed by inserting a long screw-driver through the wave-change switch and coil wiring; needless to say, this should be done while the cover of the coil box is off!

(b) If the power transformer has a 5-volt winding, use a 5Y3 rectifier. If it only has a 6.3 volt winding,

(Continued on Page 48.)



THE STORY BEHIND THE SET

The 11-valve Radio Gramophone—the proud leader of the Gulbransen-Cromwell range of modern receiving sets—with its impressive overall specification, offers entertainment "par excellence" and of infinite variety, at all times.

The full frequency coverage and effective band-spreading by virtue of the extensive dial travel, is a recognized feature of this model.

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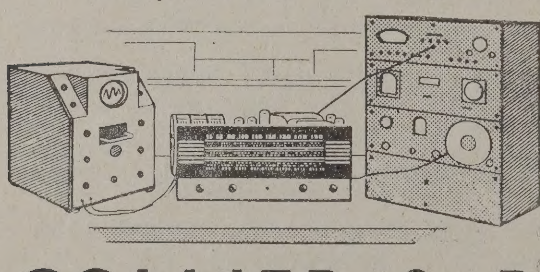

The instrument as a whole reflects the smoothness and integration of our designers, technicians, and our production team, exploiting to the full modern scientific methods and equipment.

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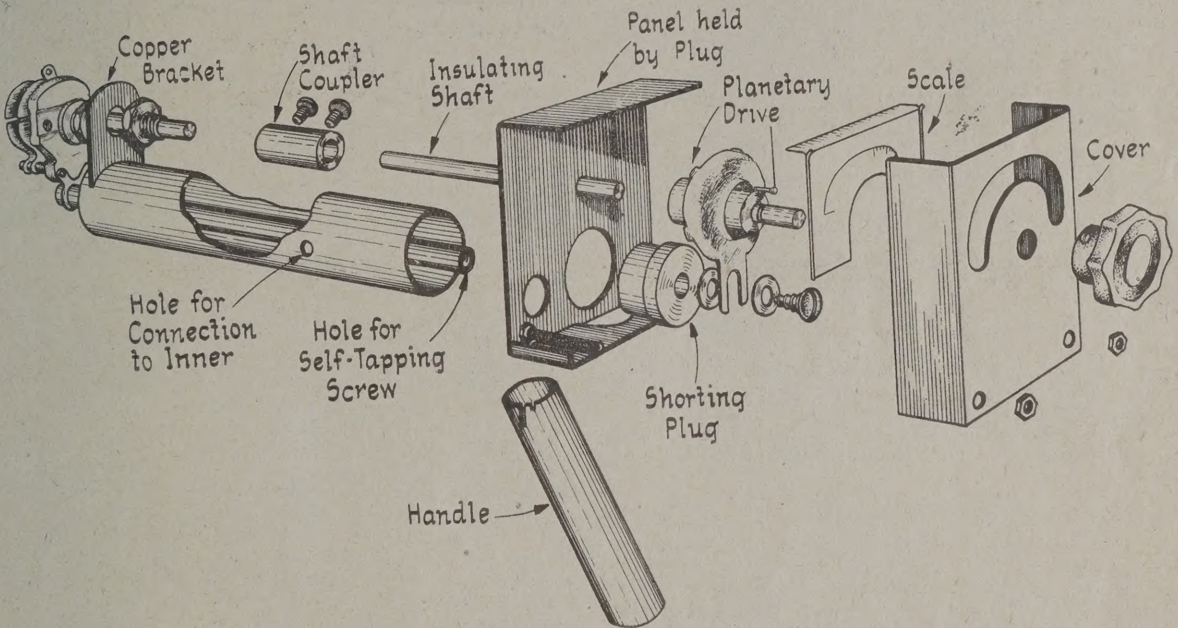
A Co-axial Line Wavemeter for the Range 250 to 500 Mc/sec.

This article underlines the natural simplicity of much equipment designed for V.H.F. and U.H.F. Although the basic design has been elaborated somewhat for reasons of mechanical convenience, the wavemeter illustrated here and on this month's front cover is fundamentally nothing more than a short length of co-axial line, tuned by a conventional variable condenser, and with a diode metering circuit as an indicator of resonance.



INTRODUCTION

We have often had reason in these pages to extol the virtues of the V.H.F. bands for experimentally-inclined amateurs, and to try to dispel some of the atmosphere of mystery that seems to surround V.H.F. equipment. Why this should exist in the first place is somewhat of a mystery in itself, because although the components and techniques of V.H.F. are certainly rather different from their high-frequency counterparts, a great deal has been written for amateurs in such periodicals as *QST*, which should have done much to familiarize them with the less conventional aspects of V.H.F. transmitters and receivers. Undoubtedly, however, one of the major difficulties with which the amateur is faced is that of frequency measurement. Up to the 144 mc/sec. band, crystal control for transmitters is not difficult to use, and this at the same time clears up all difficulties about finding the band. The next highest amateur band is, of course, the 420 to 250 mc/sec. band, and this is one of the most attractive to the experimentally minded. Its main disadvantage is the relative difficulty of generating much power, crystal-controlled, with ordinary valves. Valves can be bought that will do the job, but they are expensive. We refer to the QQE06/40 double pentode, which is an improved version of the American type 829B, and which can deliver about 30 watts at 420 mc/sec. as a straight amplifier. However, with the wavemeter described here, those who can produce signals on the 144 mc/sec. band, and measure their frequency with reasonable accuracy, should have no difficulty in calibrating this wavemeter for the 420 mc/sec band, with the same accuracy that can be obtained for the lower band. The trick is to use as the signal for the wavemeter, the third harmonic of an oscillator or other transmitter operating on the range between 140 and 150 mc/sec. While the wavemeter was primarily designed for the amateur band at 420 to 450 mc/sec., it actually covers the range from 250 to 500 mc/sec., and so will fulfil a number of other requirements as well.

CIRCUIT OF THE WAVEMETER

The circuit of the wavemeter is simplicity itself. It consists only of a piece of co-axial line, loaded with a variable capacity, which tunes it over the above-mentioned frequency range. If no loading capacity were used, it would not be tunable, and would therefore be only a single frequency device. But by using a length of line that is considerably shorter than a quarter of a wavelength, and using it as if it were the inductance of a parallel-tuned circuit, we retain the advantages of the co-axial line as a V.H.F. tuning device, and still are enabled to tune it continuously over a fairly wide range. For those who are not very familiar with the use of

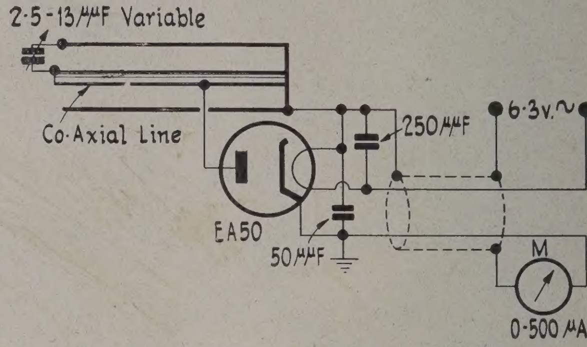
transmission lines as components of tuned circuits, it should be mentioned that the circuit is exactly equivalent to a tuned circuit, in which the tap for the diode is taken off very near the earthed end of the coil. That is all there is to it. The diode produces only very light shunting of the tuned circuit, and so allows it to have a very high Q, and very good selectivity, even at the frequencies we are dealing with. In order to make the sensitivity of the indicating meter as high as possible, only the meter resistance is used as the load for the diode. In the case of the prototype, a war surplus 500 μamp meter with a resistance of 500 ohms was used, and this made a very sensitive instrument, which would give a full-scale indication from a very low-powered oscillator even several feet from it. An oscillator working on 150 mc/sec. with an output of only about three watts, produced enough third harmonic to give full-scale deflection on the meter when this was coupled to the oscillator lines.

As can be seen from the circuit diagram, the circuit of the metering arrangement is exceedingly simple. There are only two R.F. by-pass condensers, apart from the diode valve, and because of the co-axial construction of the tuned circuit portion, in which everything attached to the outer conductor is at earth potential, there is no difficulty at all with hand-capacity, or similar unwelcome effects; the choice of ground points for the by-pass condensers is quite open. Anywhere on the metallic parts makes a satisfactory ground point, especially if the outer conductor of the flexible cable for the heater and meter leads is earthed at the same point. Even if they are earthed at different points, there will not be any trouble from R.F. currents through the metal, because the R.F. grounding in co-axial circuits is so good. Just in case, however, the operating shaft for the tuning condenser was made from bakelite rod, but it is not expected that spurious resonances would show up even if this were of metal.

CONSTRUCTION

The construction is admirably shown by the cover photograph and our draughtsman's excellent exploded view, shown here, and many words of description would be superfluous. However, there is one thing that should be mentioned. The drawing shows that the original model used a turned shorting plug, which at the same time clamped the panel between its own flange and the edge of the larger copper tube, which forms the outer conductor of the co-axial line. Few experimenters have lathes, and unless it were possible to make the wavemeter with only ordinary hand tools, we should have not gone to the trouble of writing an article about it. Instead of using the shorting plug, it would have been just as satisfactory to use the panel itself as the short circuit for the closed end of the line. This could be accomplished by drilling only a quarter-inch hole for the inner conductor to fit in, and soldering the panel directly to the end of the outer tube. This removes the only portion that needs special tools. However, the final assembly would probably be a little more difficult with this arrangement, in that the inner conductor would have to be held centrally inside the outer tube while soldering was in progress. The planetary reduction drive was held on by a self-tapping screw, working into a hole in the end of the inner conductor at the closed end of the line. In our case, thick-walled ¼ in. copper tubing was used for the inner conductor, so that the necessary hole was already there. The scale was made from the thin tinplate of a cylindrical cigarette tin, and soldered to the bent-over flange of the panel. However, there is no need to go to the complication of adding the planetary drive at all, though this does assist in accurately tuning the wavemeter. Should the shorting plug be omitted, it will be necessary to shorten the co-axial line, because the lengths quoted below for the line include the ineffective bits covering the shorting plug. These play no part in determining the tuning frequency, and so if a shorting plate is used at the extreme end of the outer conductor, its length, and that of the inner, too, should have the length of the shorting plug inside the tube deducted.

The connection to the inner conductor was made in the following way, which is not apparent from an inspec-



Circuit of the Wavemeter

tion of the drawing. The point of attachment to the inner conductor is marked off, and a hole made at the marked point with a 1/16 in. drill. A piece of 16-gauge copper wire is then soldered into the hole, and bent down in the form of an "s" so that it will go down the inside of the outer tube, with a bit sticking up that can be pushed through the hole in the outer. When a bit of the wire is showing through, it is gripped with the pliers, and the wire is gradually bent so as to allow the inner rod to be brought through until the point of attachment of the wire is directly underneath the hole in the outer. After the line has been assembled, the heavy wire can be bent so that it comes out in the centre of the hole, and it is then cut off with about half an inch protruding from the hole. This piece is afterwards soldered to the plate connecter on the end of the EA50. As can be seen, an effective job can be made even if many of the refinements of the original are omitted altogether. One of these is the handle, giving the whole thing rather the appearance of a pistol. This, however, makes the instrument very handy to hold in the left hand, while the tuning is adjusted with the right. It is, however, quite unnecessary so far as the functioning of the thing is concerned, and can easily be omitted. However, some sort of dial is necessary if the wavemeter is to be used to measure frequencies, however roughly. But if an accurate method of calibration can be found, then there is no reason why the calibration and measuring ability should not be as good as one per cent. This is mainly a result of the excellent electrical and mechanical stability of the co-axial circuit. It is robust enough mechanically to retain its electrical characteristics quite easily in spite of much use and handling.

CALIBRATION

If all else fails, the meter can be calibrated with the aid of a self-excited oscillator and some Lecher lines. However, these are not as accurate as other methods unless they are carefully constructed and used. However, if a *variable*-frequency oscillator between 140 and 150 mc/sec. is used, the results can be quite accurate, and this is probably the easiest method of calibration in cases where no special facilities exist. The method here is simply to set the oscillator to 140 mc/sec. by means of

the lecher lines, used to measure the fundamental frequency. Then the wavemeter is brought close to the oscillator valve, and the condenser is tuned until a response is found. If the wavemeter has been built according to specification, then two response points will be found, one at 280 and the other at 420 mc/sec. Both these calibration points can then be marked in on the dial. The oscillator is then adjusted to higher frequencies within the range 140 to 150 mc/sec., and for every point the wavemeter is tuned in and the appropriate frequency marked on the dial. If any crystal oscillators are available that will frequency multiply into the range 140 to 150 mc/sec., these can be used as a check on the Lecher line measurements, and will serve to give some idea of how well the calibration has been done. There is no reason why the method just outlined should not be used to calibrate the whole dial of the wavemeter, using the second and third harmonics to excite the wavemeter. It may be found that with some V.H.F. oscillator circuits, the output is very low on the second harmonic. This is usually the case with push-pull parallel line oscillators, and indeed with any parallel line oscillators, since the second harmonic is unable to set up a standing wave on the tuning line that has one voltage node (or current loop) corresponding to the actual short circuit of the line.

DIMENSIONS OF THE CO-AXIAL LINE

For the frequency range under discussion, the tuning condenser used was one with a capacity range of 2.5 to 13 $\mu\mu$f. Thus, it can be seen that there is appreciable capacity shunted across the line, even at the highest frequency in the range, and, as a result, the line will be a good deal shorter than a quarter of a wave length at the highest frequency in the tuning range. For example, a quarter-wave at 500 mc/sec. is 5.9 in., but the actual length of the line used in the finished instrument was only $2\frac{5}{8}$ in., measured from the open end to the inside surface of the shorting plug. Calculation from the known minimum capacity of the variable condenser gave a length for the line of $3\frac{1}{2}$ in., so that the extra $\frac{7}{8}$ in. that had to be cut off is accounted for by additional sources of minimum capacity at the end of the line. One of these is the capacity between the outer conductor and the double strap used to connect the inner conductor to the stator plates of the variable condenser. Another source of extra capacity is the fact that the inner conductor was extended about a quarter of an inch beyond the end of the outer conductor.

The line is made from 1 in. outside diameter copper tubing with a 16 gauge wall, and the inner conductor was a piece of quarter-inch O.D. copper tube, with thick walls, leaving a central hole of about 1/16 in. diameter. The total length of the copper outer tube was

(Concluded on Page 48.)

TUBE DATA: The EQ80 F.M. Detector Valve

This valve has been developed in an attempt to overcome some of the natural disadvantages of the ordinary discriminator-type of detector commonly used in F.M. receivers. It works on an entirely different principle from previous F.M. detector circuits, and, in addition to providing the audio signal in its plate circuit, acts inherently as a limiter, for all signal amplitudes greater than a particular voltage. Basically, the valve is a detector of

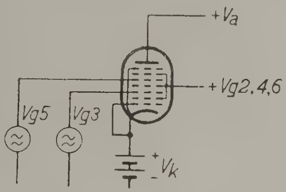


Fig. 1

phase differences between two R.F. voltages. Its electrode structure is illustrated diagrammatically in Fig. 1. It will be seen that there are a plate, a cathode, and seven grids. In spite of this, the functioning of the tube is not as complex as might at first be supposed. Grid 1 is connected to the cathode in normal use, and acts simply as a space-charge grid. After this comes grid 2, which has the character of a screen grid, and is held at a constant positive potential of about 20 volts, G_3, the next one is a signal grid. G_4 is another screen grid, internally connected to G_2. G_5 is the second control grid, and G_6 is another screen-grid, internally connected to G_4 and G_2.

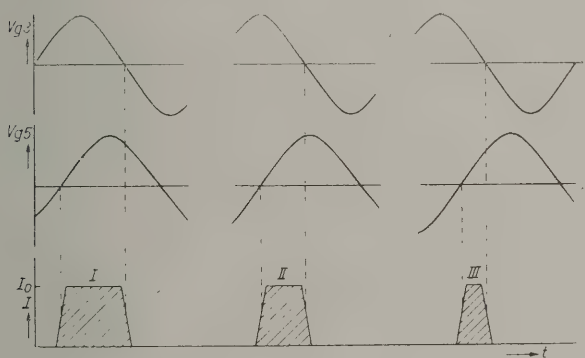


Fig. 2

G_7 is a suppressor grid, like that of a conventional pentode, and is connected internally to the cathode.

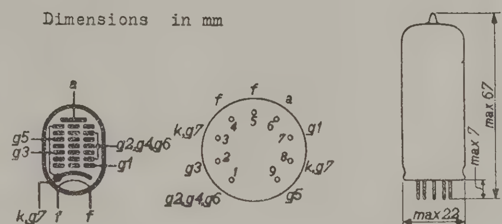
The first essential point about the operation of the valve is that the total cathode circuit is almost entirely determined by the positive potential on G_2, so that whatever signal voltages are applied to G_3 and G_5, these have little or no effect on the cathode current. What they do affect, however, is the distribution of the cathode current between the following screen grids, and, most important of all, the plate. For example, if G_3 is sufficiently negative, practically all the emitted electrons flow to G_2, and none to G_4, G_6, or the plate. If G_3 is positive, almost all the electrons pass through it, and are collected by either G_4, G_6, or the plate. Here, the main point of interest is that for sufficiently negative values of voltage on G_3, the plate current is cut off. The second control grid, G_5, has the same sort of action as G_3. That is to say, if it is sufficiently negative, all the electrons passing through G_4 are turned back, so that no current flows to G_6 or the plate. If G_5 is positive, then the electrons can pass through to G_6 and the plate. Thus, we have two control grids, both of which must be positive before any plate current can flow. If either control grid is negative, then the space current is diverted to the various screens, and no plate current flows, while if both are positive, a constant plate current flows, which is independent on the

ENNEODE for use as F.M. detector and limiter and as A.F. amplifier

Heating: indirect by A.C. or D.C.; parallel supply

Vf = 6,3 V
If = 0,2 A

Dimensions in mm



Base, Noval

Capacitances

Cg1	=	4,5 pF
Cg3	=	6,3 pF
Cg5	=	8,7 pF
Ca	=	9,6 pF
Cag1	<	0,4 pF
Cag3	<	0,15 pF
Cag5	<	0,35 pF
Cg3g5	<	0,4 pF
Cg1f	<	0,2 pF
Cg3f	<	0,15 pF
Cg5f	<	0,15 pF

amplitude of the positive voltage on G_3 and G_5. It is obvious from this, that if the R.F. voltages fed to G_3 and G_5 are greater in amplitude than a certain critical value, the peak plate current will be constant, and effective limiting will have been obtained. At the same time, if two equal voltages are applied to the control grids, the amount of current taken by the plate in each cycle will depend on the relative phase of the two voltages. For example, if the two voltages are exactly out of phase, no plate current at all will flow, since under these conditions, at no time are both G_3 and G_5 positive at the same time. If the voltages are in phase, then both grids go negative on negative half-cycle, and there is no plate current during this period, but both grids go positive on the positive half-cycles, so that plate current flows for the whole of each positive half-cycle. These two illustrations are, in fact, the extremes, which are not reached in normal

operation, which is illustrated in Fig. 2. Here at (c) is shown the plate current waveform, for three values of phase difference between the inputs of G_3 and G_5. The plate current alternates between its maximum value and zero, according as both grids are positive, or either of them is negative. Of course, the area under the plate current pulses is proportional to the D.C. plate current in each case, since the latter is the sum of the individual pulses, one of which occurs in each R.F. cycle. At 90°

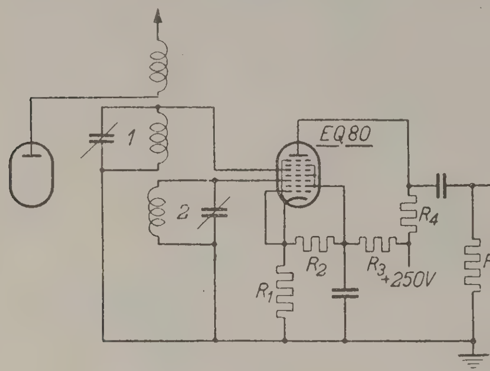
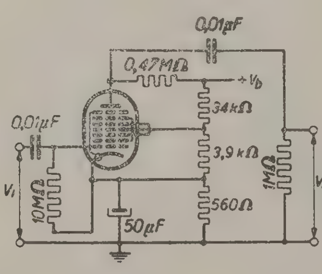


Fig. 4

phase difference, the plate current is intermediate between the values for 50° and 130°, and it can be seen that the extreme cases of 0° and 180° will be maximum and zero plate current, respectively. In Fig. 3 is shown a series of curves of D.C. plate current versus phase difference, with equal voltages applied to the grids. It can be seen

Operating characteristics as A.F. amplifier



V_b	=	250 V
I_a	=	0,28 mA
g	=	150
d_{tot} (V_o = 15 V_{eff})	=	2,8 %

This valve can be used without special precautions against microphonic effect in A.F.amplifier circuits if the input voltage V_i is ≥ 25 mV for an output of 50 mW of the output stage

that for phase differences between 50° and 130° the D.C. plate current change is a linear function of phase difference, and quite independent of the signal amplitude. Thus, if the arrangement is to be used as a detector of frequency-modulated waves, it is only neces-

Limiting values

V_{a_o}	=	max. 550 V
V_a	=	max. 300 V
W_a	=	max. 0,1 W
$V_{(g2+g4+g6)_o}$	=	max. 250 V
$V_{g2+g4+g6}$	=	max. 100 V
$W_{g2+g4+g6}$	=	max. 0,1 W
I_k	=	max. 3 mA
V_{g1} (I_{g1} = +0,3 µA)	=	max. -1,3 V
V_{g3} (I_{g3} = +0,3 µA)	=	max. -1,3 V
V_{g5} (I_{g5} = +0,3 µA)	=	max. -1,3 V
R_{g1}	=	max. 1 MΩ[1]
R_{g3}	=	max. 3 MΩ
R_{g5}	=	max. 3 MΩ
R_{kf}	=	max. 20 kΩ
V_{kf}	=	max. 100 V

[1]) With grid biasing R_{g1} = max. 22 MΩ.

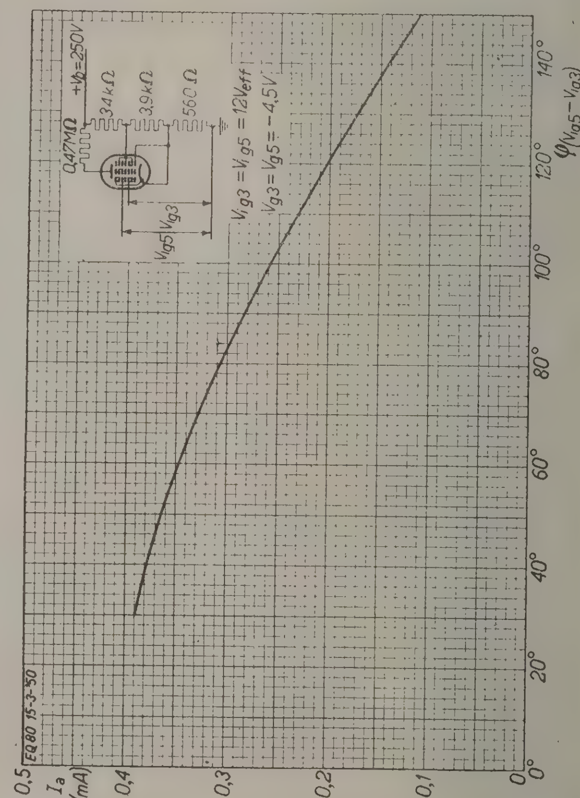
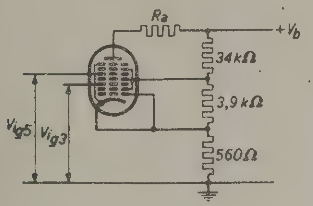


Fig. 3

sary to convert the frequency variations in the signal into phase variations, and arrange for two R.F. voltages, initially 90° out of phase, to vary their phase in opposite

Operating characteristics as F.M.detector and limiter



V_b	=	250 V
$V_{g2+g4+g6}$	=	20 V
V_{g3}	=	-4 V
V_{ig3}	=	12 V_{eff}
V_{g5}	=	-4 V
V_{ig5}	=	12 V_{eff}
$\varphi(V_{ig3}-V_{ig5})$	=	90°
R_a	=	0,47 MΩ
I_a	=	0,28 mA
$I_{g2+g4+g6}$	=	1,5 mA
I_{g3}	=	0,09 mA
I_{g5}	=	0,03 mA
R_i	=	5 MΩ

This valve can be used without special precautions against microphonic effect in F.M. detector circuits if the input voltage of the next stage V_i is ≧ 1,0 V for an output of 50 mW of the output stage

senses as the frequency of the signal changes. This is considerably easier to do than saying it suggests. For example, if we have a double-tuned transformer, the voltages across primary and secondary are equal, in the absence of losses, and are 90° out of phase with each other *when the signal is at the common tuned frequency.* When the signal frequency varies, the phase of the voltage across the two tuned circuits changes, in a manner approximately proportional to frequency, so that the required phase changes take place, and the audio frequency changes in frequency of the signal are translated into changes of plate current.

The basic circuit for the use of the EQ80 is shown in Fig. 4 together with approximate circuit values. An untuned primary is inductively coupled to two tuned secondaries, one each feeding a control grid of the EQ80. The screens are fed from a voltage divider, and an audio load resistor is placed in the plate circuit. For efficient limiting, the signal voltage to each grid should be eight volts or greater. In this event, virtually perfect limiting will be obtained. For phase swings of 60° to 120°, the output voltage of the EQ80 is 16 volts R.M.S., indicating that it can feed a power amplifier stage directly. Distortion under representative F.M. conditions can be kept to as little as 0.3 per cent., so that the valve should be quite satisfactory for high-fidelity applications. Since the output voltage is so great, distortion can be lowered considerably, at the sole expense of output voltage, by suitable design of the I.F. transformer so that the phase swing is automatically limited to small values, independently of the frequency swing of the transmission.

Advantages that should be obtained with this valve are (a) the critical adjustment of normal discriminator circuits is avoided; (b) separate limiter stages are not

(Continued on Page 48.)

The "RADIO and ELECTRONICS" Abstract Service

ANTENNAE AND TRANSMISSION LINES

Some simple ways of erecting temporary or semi-permanent antennae for the amateur who loves the wide open spaces. There is always a difficulty in getting an aerial to a useful height, and the writer advocates the use of a bow and arrow with all seriousness. A nylon thread is attached to the arrow which is fired over a tree branch. Other useful hints are given.

—*Q.S.T.* (U.S.A.), March, 1952, p. 41.

AUDIO EQUIPMENT AND DESIGN

The fundamental purpose of the acoustic horn is to match the impedance of the core or diaphragm to the impedance of the space into which the sound is to be propagated, hence its special value. An exponential horn, however, is not admirably suited to furniture design, but the designs given are aesthetically pleasing.

—*Audio Engineering* (U.S.A.), March, 1952, p. 22.

How to use magnetic pick-ups. Some find it advantageous to replace crystal cartridges by magnetic cartridges which are deemed capable of better performance, but certain adaptations are necessary by way of pre-amplifiers, which are described.

—*Ibid,* p. 35.

How good is an audio transformer? The important characteristics of a transformer are: core loss, winding resistance, interwinding capacitance, capacitance to ground or core, and leakage reactance. The performance at high and at low frequencies is what distinguishes the good from the bad.

—*Ibid,* p. 14.

The problem of keeping a phonograph pick-up tangent to the record grooves at different radii is perennial. The article deals with side thrust, tracking error distortion, arm design and mounting, and tracking equations.

—*Ibid,* p. 17.

CIRCUITS AND CIRCUIT ELEMENTS

The distributed amplifier described. For any given type of amplifier there is a "maximum bandwidth gain product." By connecting valves in parallel the increase in gm is offset by the corresponding increase in input and output capacitances. In the distributed amplifier the mutual conductances effectively add while the input and output capacitances remain separate. The valves have their grids connected along a transmission, and also the anodes. All signals arrive additively at the end of the line in phase.

—*Electronic Engineering* (Eng.), April, 1952, p. 144.

ELECTRONIC DEVICES

The Australian multiple-trace-range (M.T.R.) for aircraft provides accurate azimithal bearing information; a typical system provides 66 flight paths into or out of an air terminal. The fundamental technique is the accurate measurement of the time interval between a pair of R.F. pulses. The system is suitable for light aircraft.

—*Proceedings of the I.E.E.,* Part III, No. 58, p. 88.

Design problems of magnetic amplifiers have been mastered by a technique relating to core construction arrangement and proportioning of windings and circuiting. The construction of precision amplifiers is possible with a wide range of input impedances and output requirements.

—*Proceedings of I.R.E.* (U.S.A.), March, 1952, p. 261.

"Bimorph" piezoelectric crystals are part of a high-speed clutch. The expansion of the crystals causes the bendng of the elements so that the clutch can deliver useful torque in as little as 0.2 miliseconds after voltage is applied. The clutch is for use in instruments and apparatus such as movie cameras.

—*Electronic Engineering* (Eng.), April, 1952, p. 165.

A supplement in the magazine contains a very interesting series "Electronics in Industry." It deals with: Industrial aplications, automobile research; a precision dental reflectometer, automatic production handling, quantity control, high frequency heating progress, and other subjects.

—*Ibid,* p. 187.

INSTRUMENTS AND TEST GEAR

An electrical flowmeter for recording blood flow; a special cannula is inserted into the pulmonary artery. The instrument embodies a differential capacitance manometer that registers the pressure output.

—*Electronic Engineering* (Eng.), April, 1952, p. 162.

A simple metre is described for checking small condensers; the unknown is connected across a fixed condenser in series with a calibrated condenser and coupled to an oscillator. The meter was built to measure condensers before being used, but a fairly close measurement can be made on those already wired in, which is very convenient.

—*Q.S.T.* (U.S.A.), March, 1952, p. 58.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

Printed circuitry is no longer confined to a few military devices and hearing aids, but may now be encountered in everyday equipment. By its use a relatively unskilled operator can produce hundreds of complex units in quick time.

—*Radio and Hobbies* (Australia), April, 1952, p. 77.

The life span of oxide cathode receiving valves is a subject almost devoid of literature. The paper attempts to integrate all information on the subject. It is concluded that most present-day valves fail from functional causes, from gross emmission deterioration due to gas attack or excessive interface feedback.

—*Proceedings of the I.E.E.* (Eng.), Part III, No. 58, p. 88.

A travelling wave cathode-ray tube has been developed which will record single non-recurrent transients of 0.5 millimicroseconds rise time. Lower deflection factors and lower transit time distortion have been achieved by the use of travelling wave deflectors. This is a novel method of introducing waveguide technique to the cathode-ray tube.

—*Proceedings of the I.R.E.* (U.S.A.), March, 1952, p. 297.

An outline of some of the major design features of cold cathode discharge tubes especially suitable for counting devices and other circuits.

—*Electronic Engineering* (Eng.), April, 1952, p. 152.

PROPAGATION AND MODULATION

The paper describes an experimental study of fading over a sea path within radio horizon at a wavelength of 3 cm. The object of the investigation was to record the general fading characteristics for the seasons and to present the results in such a form that the effects of fading on the operational ranges of radar equipments could be readily appreciated. The power required of a beacon is estimated from the data.

Proceedings of the I.E.E. (Eng.), Part III, No. 58, March, 1952, p. 53.

In December, 1951, a large number of high frequency stations in the U.S.A. participated in new technique to predict and verify skywave transmission. By using the method discussed it is possible to determine whether or not a band is "open" in a given direction, and to what distance. The determination can be made at the transmitter by detecting "scatter" or reflected energy from bodies at the end of the skip distance, and is not dependent on other stations being on the air. This is a very important paper for amateurs.

—*Q.S.T.* (U.S.A.), March, 1952, p. 22.

One form of speech clipping is demonstrated by overloading an audio system, and the article describes how the principle is applied to speech clipping at the transmitter. If used in moderation it will give the signal about twice as much punch, and speech will remain clean.

—*Ibid,* p. 54.

TELEVISION

Recent developments in television include the "Zoom" lens which has a continuous variation of focal length up to a ratio of 5:1; also microphones which can be worn on the lapel to feed into a radio link instead of a cable, so that commentators have completely free movement; mobile transmitters with elevating ladders for the antenna; new multi-hop technique in the 4500 mc/sec. range.

—*Electronic Engineering* (Eng.), April, 1952, p. 158.

A description of dot-interlace television. All have heard of line interlace and dot interlacing is rather on the same lines. The amount of information in a given bandwidth is limited. The system therefore uses the artifice of "sampling" the frequency at regular intervals and transmitting the samples in a certain form for the formation of an interlaced raster.

—*Ibid,* p. 166.

TRANSMITTERS AND TRANSMITTING

The construction of an all-band mobile transmitter is given which has the special merit of compactness and the set measures only 6 in. x 6 in. x 9 in. The circuit has several novelties to effect the coverage of 4 to 29 mc/sec.

—*Q.S.T.* (U.S.A.), March, 1952, p. 22.

As time goes by tube designers continue to make it easier and less expensive to build efficient V.H.F. transmitters. The newly announced 6146, a low-drive tetrode for use at frequencies up to 175 mc/sec., and with an output up to 50 watts is obtainable. A circuit is given for a suitable transmitter for the new tube, which may be of interest to some designers.

—*Q.S.T.* (U.S.A.), March, 1952, p. 42.

MISCELLANEOUS

In Great Britain it has been found that in houses with television a high percentage of young are home at night against a much lower percentage in homes without television. For the moralists, who would keep the young at home in the evenings, there is comfort to be drawn from this. A brief survey is given of the social implications of television.

Proceedings of the I.E.E. (Eng.), Part III, March, 1952, p. 51.

Proper Use of By-Pass Condensers

By the Engineering Department, Aerovox Corporation

In modern electronic circuits the capacitor is used more frequently for the function known as "by-passing" than for any other single application. The selection of a capacitor of the proper type and value for a given job is an important aspect of circuit design. Such critical performance characteristics as frequency response, phase distortion, circuit stability, and freedom from parasitic oscillations are determined by the by-passing used. This discussion is intended to provide a review of this subject for the benefit of the amateur, experimenter, young engineer, or anyone who has been puzzled by the problem of what by-pass to use for a specific purpose. The factors underlying the choice of capacitors in typical circuits will be pointed up by the use of examples.

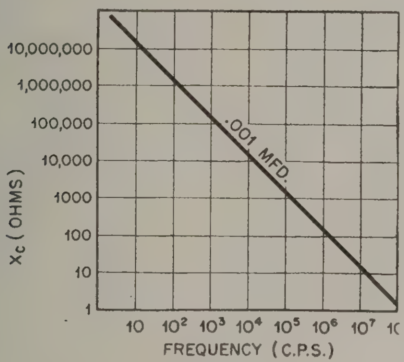


FIG. 1

"By-passing" can be defined as providing a short, low impedance path around certain circuit components for electrical currents of some frequencies while maintaining a high impedance path for other frequencies. The circuit designer is repeatedly confronted with the need of components having this property of passing currents of a desired periodicity while excluding others. Actually, both inductances and capacitors qualify under this definition because of the frequency discriminating action of these simple filters. An inductance, or "choke," may be considered to be a low frequency by-pass element since it presents a low impedance path for D.C. and low frequencies while presenting a high reactive impedance for high frequencies. The condenser, on the other hand, is a simple high-pass filter, having a high reactance at low frequencies and becoming more nearly a short circuit as frequency is increased. It is when this latter property is used to provide a "detour" around some part of a circuit that the term *by-passing* is most commonly employed.

For a capacitor to function as an effective by-pass, its impedance must be much lower than the impedance of the circuit element being by-passed. Of course, the reactive impedance of a capacitor of any value is easily calculated for any given frequency from the basic expression:

(1)

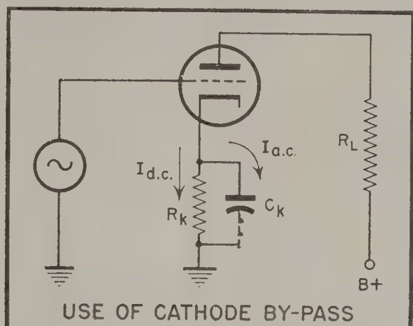
$$X_c = \frac{1}{2\pi fC}$$

where:

X_c is the capacitive reactance in ohms
f is the frequency in cycles per second
C is the capacitance in farads.

Provided that $X_c >> X_L$. X_L = lead reactance.

Needless to say, this relationship is of constant use in designing proper by-pass circuits. It shows that the reactance of a given unit decreases with frequency or that, for a given frequency, a value of capacity can be chosen to given any desired value of capacitive reactance. To aid in visualizing this function, we have plotted the reactance of a .001 μf. condenser versus frequency in Fig. 1.



USE OF CATHODE BY-PASS
FIG. 2

CATHODE RESISTOR BY-PASSING

The most frequent use of the by-pass condenser is illustrated in Fig. 2, where the capacitor is used as a *cathode resistor by-pass.* The necessity for this is obvious when the characteristics of the circuit are considered. As is well known, any vacuum tube stage which uses cathode bias exhibits strong degeneration if the signal current is allowed to flow through the bias resistor. This is so, as the A.C. component of the plate current flowing through the bias resistor develops a voltage drop across it during signal peaks which increases the bias applied to the grid of the tube. This has the effect of reducing the signal voltage on the tube grid and thus reducing the stage gain and introducing phase distortion and other undesirable results.

In Fig. 2, this degenerative effect is prevented by shunting the cathode bias resistor with a capacitor which by-passes the A.C. signal component around it. Let us now consider the requirements placed upon this capacitor.

Assume that the stage depicted in Fig. 2 is an audio amplifier intended to work over the frequency range of 200 and 5,000 c.p.s. and that the cathode resistor recommended for the tube type used is 300 ohms. A by-pass capacitor must be provided across this resistance which will prevent most of the audio frequency plate signal current from flowing through it. Since the reactive impedance of the condenser becomes lower with increasing frequency, as shown by Eq. 1, one which is satisfactory at the low frequency end of the desired range will do for the entire range. Therefore, in the present example, a capacitor which effectively by-passes the 300-ohm cathode resistor at 200 c.p.s. should be adequate. Most circuit designers consider a ratio of bias resistance to by-pass reactance

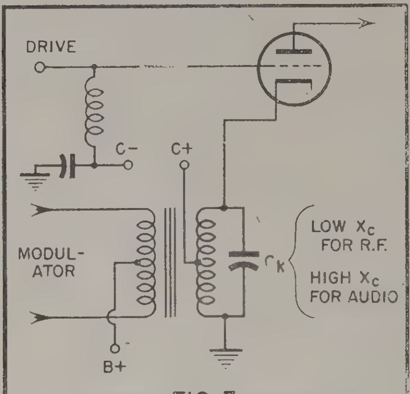
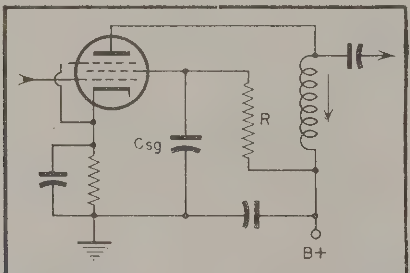


FIG. 3

of about 10-to-1 to be a safe rule-of-thumb for most work. With this ratio more than 99 per cent. of the total A.C. current flows through the by-pass condenser. Ratios up to 20-to-1 may be used in high fidelity amplifier work where space and economical considerations permit, however.

Assuming a by-pass ratio of 10-to-1 to be sufficient, a capacitor having a reactance of one-tenth the resistance of the bias resistor at 200 c.p.s. is necessary. By rewriting Eq. 1 to solve for a value of capacitance having a reactance of 30 ohms, an answer of 26 microfarads is obtained. Therefore, the nearest standard value of 25 microfarads would be used. An electrolytic condenser is usually used in this application since leakage resistance is not important in this case and these units are compact and economical. The capacitor must be rated for a working voltage greater than the maximum bias voltage developed. This may be obtained from Ohm's Law, using the bias resistance and the maximum D.C. current which flows through it. For pentodes, this means both the plate and screen current, and for classes of amplification other than Class A requires the maximum-signal current. A voltage rating of 25 or 50 volts is usually sufficient for cathode by-passing.



SHOWING USE OF SCREEN BY-PASS
FIG. 4

In the example discussed above, the cathode by-pass could have been made large without limit, without detrimental effects on circuit performance. Circuits exist, however, in which there is an upper limit to the capacitance which can be used to by-pass an impedance in the cathode circuit. As an example, consider the cathode-modulated Class C R.F. amplifier shown in Fig. 3. Here the condenser is required to by-pass R.F. around the modulated transformer. Otherwise regeneration may result from feedback into the grid bias circuit. However, if the cathode by-pass is made too large, the modulation frequencies will be shunted to ground. A value of capacitance must be chosen which has very low reactance at the carrier frequency, but a high one at the highest modulation frequency. Fortunately, this is easily done in this case because of the wide difference in the frequencies involved; a .002 microfarad condenser has a reactance of about 8.0 ohms at an R.F. frequency of 10 mc/sec. but almost 16,000 ohms impedance at 5,000 c.p.s. A good mica or ceramic condenser of low inductance would be used in this application.

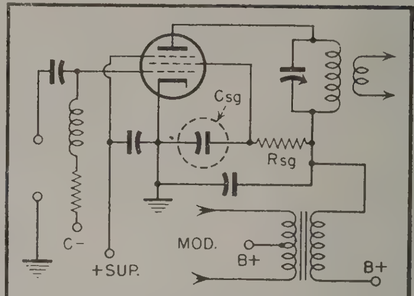


PLATE-SCREEN MODULATED
PENTODE STAGE
SCREEN BY-PASSED FOR R.F. (Csg)
FIG. 5

Of course, not all cathode bias resistors must be by-passed. In many high fidelity audio amplifiers and television I.F. amplifiers controlled amounts of negative feedback are introduced to improve the over-all performance. In such cases, the loss of gain is compensated by adding extra stages. Cathode by-passing is also omitted in Class A push-pull amplifiers, since

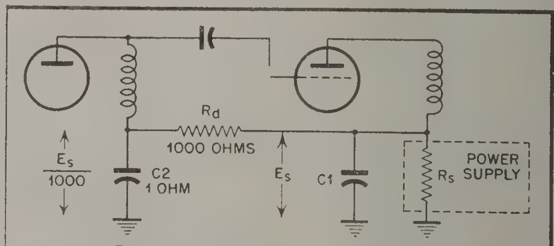
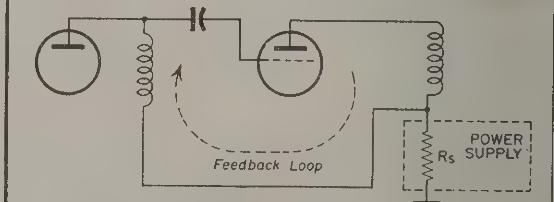
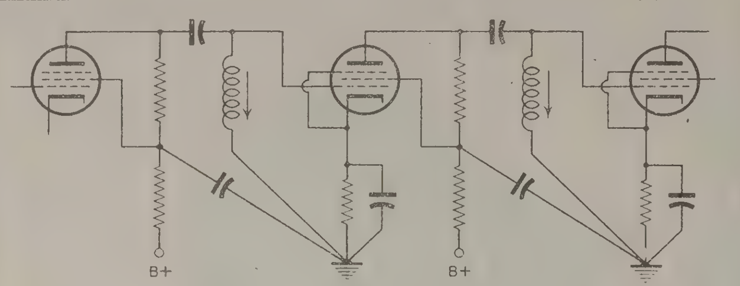


PLATE LEAD DECOUPLING FILTER
FIG. 6b



FEEDBACK DUE TO
COMMON POWER SUPPLY IMPEDANCE
FIG 6a



ILLUSTRATING USE OF BY-PASS GROUND POINTS

FIG. 7

above. For example, consider the television I.F. amplifier stage shown in Fig. 4. Here the screen voltage is derived from the plate supply through a dropipng resistor. If the A.C. signal component is allowed to pass through the screen dropping resistor, the gain of the stage will be reduced. For this reason, a by-pass condenser is used to ground the screen for signal voltage without interfering with the application of the D.C. screen voltage. If the screen by-passing is imperfect at any frequency, the response of the amplifier will fall off there or it may oscillate. It is common practice to make the screen by-pass reactance small compared with the cathode-to-screen impedance. This is obtained by dividing the screen voltage by the screen current.

Mica or ceramic condensers are used in condensers ranging from 10 micromicrofarads to .01 microfarads

the A.C. signal components of both tubes flowing in the resistor are out of phase and cancel out.

SCREEN BY-PASSING

The screen element of tetrode and pentode electron tubes must be effectively by-passed to ground for all signal voltages present. This is necessary to prevent degeneration of a type very similar to that discussed

for radio frequencies, while high quality paper units and electrolytics are used for audio screen by-passing. As in cathode resistor by-passing, certain circuits require screen by-passing sufficiently heavy to ground the screen for R.F. but not for audio frequencies. A typical example of such selective by-passing would be the plate and screen modulated Class C amplifier shown in Fig. 5. In this circuit the screen voltage must vary with the modulation and so should not be by-passed for audio frequencies. A .002 microfarad condenser is sufficient in most cases and does not result in a loss of "highs."

PLATE CIRCUIT BY-PASSING

As in the cathode and screen circuits discussed above, any impedance in the plate circuit of a vacuum tube stage is common to another stage, or another part of the same stage, can cause feedback and instability if not properly by-passed. The reasons for this are obvious from Fig. 6a. Here the plate voltage for two stages of an I.F. amplifier is taken from the same power supply and no *decoupling* is employed. The internal impedance of the power supply is represented by Rs. Since the plate signal current is allowed to flow through Rs, a voltage drop is developed across it which is introduced into the plate circuit of the preceding stage via the plate lead. This signal voltage is then fed to the grid circuit of the second stage, with the result that oscillation will occur if the stage gain is high enough.

Instability due to plate circuit feedback is prevented by the use of decoupling filters consisting of series isolating resistors and by-pass condensers, as shown in Fig. 6b. Such decoupling networks are most easily understood if thought of as voltage dividers at the feedback signal frequency. For example, in Fig. 6b assume that the internal impedance of the power supply (Rs) is imperfectly by-passed by C_1 at the signal frequency. A small signal voltage (Es) is therefore developed across the power supply impedance and travels down the plate lead to the preceding stage. The function of the decoupling filter Rd and C_2 is to greatly attenuate this signal since they divide it in the ratio of their impedances. Thus, if the reactive impedance of C_2 is only 1 ohm and the resistance of Rd is 1000 ohms, the fed-back signal is divided by that ratio so that only 1/1000th of the voltage developed across the power supply impedance is applied to the preceding stage. Of course, the D.C. plate voltage is unaffected except for a small IR drop across Rd. In cases where this drop couldn't be tolerated, an inductance could be used in place of Rd. Several such RC or LC decoupling filters are sometimes used in series in cases where feedback is particularly troublesome.

BY-PASSING PRECAUTIONS

By-pass wiring in some circuitry, including high gain amplifiers and V.H.F. circuits, must be done with extreme care to avoid common impedances which introduce feedback. The safest rule for by-passing multistage amplifiers is to ground all by-passes associated with the output of one stage and the input of the next stage to a single ground point, as in Fig. 7.

In applications where very effective by-passing at a single frequency is required, some designers have resorted to the use of *series resonant by-passing*. By this method, the capacitance of the condenser is resonanted with the

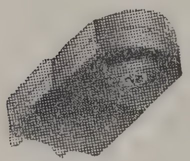
(Concluded on Page 48.)

Audio Men

who want the best will want

PICKERING COMPONENTS

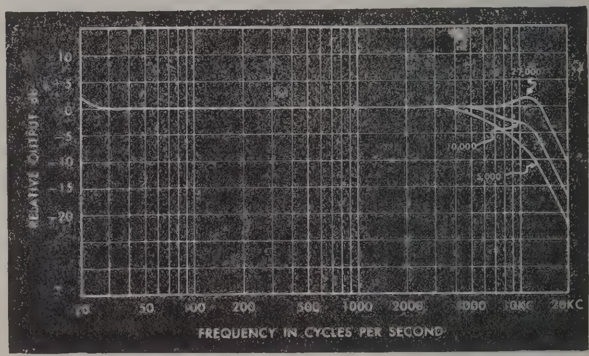
when they are available in New Zealand

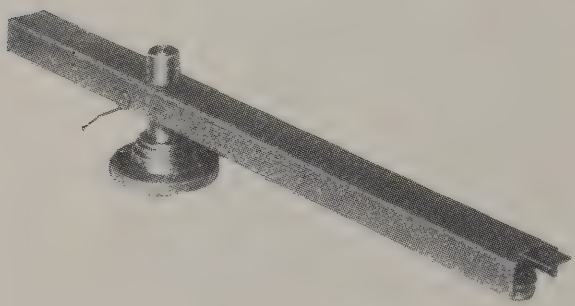


Pickering Cartridges

With diamond or sapphire stylus, for standard or microgroove records, are the first choice of America's professional audio engineers for high-quality reproduction.

Each cartridge is carefully tested at the factory for frequency response, waveform distortion, output level, and tracking pressure. Optical parts and electrical inspection of the pick-up coil are made on each unit. Users report absolute stability, amazing ruggedness, and complete insensitivity to effects of temperature and humidity.





190 Pick-up Arm

The Pickering is the only arm capable of optimum performance on both microgroove and standard records. Investigation by Pickering engineers showed that arms which perform well on standard records will not necessarily do so on microgroove. In fact, no commercially available arm was found which would meet all requirements. The Pickering arm embodies all the features determined as significant and important to enable a high-quality cartridge to play microgroove records without distortion or record or stylus wear. (1) The ratio of vertical-to-lateral moment of inertia is as low as possible. (2) The vertical mass has been minimized in order to track any record without imposing extra vertical load on grooves; it plays badly warped records just as well as flat ones. (3) There is no spurious arm resonance at any frequency. (4) Pivot friction is lower than 3 gram centimetres and the bearings are rugged and trouble-free. (5) The arm is statically balanced about the vertical axis to eliminate tendency to jump grooves when subjected to bumping or jarring. (6) Offset head reduces tracking error to less than plus or minus $2\frac{1}{2}\%$. (7) Stylus point is protected against contact with anything but the record grooves; it cannot strike the turntable mat or centre pin; it plays all sizes of records up to $17\frac{1}{4}$ in. O.D. In addition, the 190 Pick-up Arm features: Sensitive tracking force adjustment; height adjustment for turntables from $\frac{1}{2}$ in. to 2 in. high; one-hole mounting and self-contained levelling screws; plug-in cartridge-holder; magnetic arm rest; stylus point completely visible for starting and cueing records; $16\frac{3}{4}$ in. long. Pickering Cartridges used with the 190 Arm require 50% less vertical tracking force than is required when using conventional arms.

PICKERING

Those interested will be invited later to hear —— this equipment demonstrated. ——

AND COMPANY, INC., OCEANSIDE, LONG ISLAND, NEW YORK

SHOES and SHIPS

"The time has come," the Walrus said
"To talk of many things. . . . "

By Special Arrangement with the Walrus

ELECTRONICS IN SPACE

Recently, a young schoolboy of apparently tender years cornered the writer in his den and began asking a series of searching questions about high frequency oscillators. As the conversation progressed, it became apparent that the young fellow was after more than ordinary high frequency valves and actually was thinking in terms of magnetrons around the 3,000 megacycle mark, his object being the possibility of penetraitng the Heaviside Layer with a view to controlling the flight of rockets!

Now, whether the young seeker after information was actually being a bit ambitious or not the writer is not prepared to say, but it started an interesting train of thought—despite the seemingly fantastic nature of space travel it is not nearly as impossible as it might first appear. Unfortunately, a lot of lurid popular science publications have put the whole subject in rather the wrong perspective for the average man. However, in the light of present-day scientific knowledge, the chances of a future generation being able to visit other heavenly bodies seems to be completely possible. During the last war the Germans were launching V2 rockets that were travelling to very considerable heights before returning to earth in a most unpleasant manner for the recipient. It is therefore a certainty that those models have been improved upon in later years and will continue to be improved upon until something is evolved which will get well beyond the earth's gravitational pull and so will not return.

What, then, has all this to do with electronics? Obviously quite a lot. The first projectiles will be launched purely for obtaining information on various aspects of the flight, and this will call for the relaying of intelligence from the rocket back to earth by means of radio in much the same manner as radio-sonde weather information is obtained today. The other big aspect of radio in this connection will be in the actual control of the flight of the projectile and this will be of primary importance. For those doubting souls who believe it will not be possible to get radio waves out from the earth far enough to prove of any value, we would remind them of the radar demonstration put on at the Festival of Britain where a large radar installation presented displays of reflections from the moon!

In order to penetrate the Heaviside Layer very high frequency propagation is an essential and the higher the frequency the better the penetraton will be. Fortunately, radar techniques are so far advanced today that this problem is virtually overcome.

No doubt in the light of future developments, modifications and improvements will be called for and provided; but fundamentally, the facility for controlling the flight of the rocket could be done.

Some people may think the tremendous acceleration necessary for the rocket to break free from the earth's gravitational pull will prove too destructive to radio equipment, but then it must also be remembered that a radio proximity fuse was in use by anti-aircraft batteries during the last war. This particular piece of hellishness consisted of an anti-aircraft shell complete with small radio set in the nose which exploded the shell when it arrived at a certain distance from an aircraft. If, therefore, electronic gear can be made to withstand the shock of being fired from a gun, the rocket should not prove too bad, although of necessity the equipment will need to be more complex. Anyway, come to think of it, if the switching on of the equipment can be delayed until outer space is reached, there won't be any need for envelopes around the valves—glass or otherwise!

Many people will, of course, ask why it is necessary for human beings to go careering off from this world, which despite politicians and atom bombs is not too bad for life as we know it. One of the prime reasons is that man from his very inception has sought to overcome the problems that beset him, and the lure of the unknown has proved one of the greatest attractions to the adventurous side of his nature. Just as in the older days men like Columbus and Tasman defied those gloomy souls who prophesied death and destruction was all that would be found far out on the high seas, and went off to see for themselves much to the advantage of mankind. So it is today, with the advent of the aeroplane and modern methods of travel, most of the world has been explored, most of the mountains have been climbed or at least flown over in an aeroplane, and most of the big rivers followed to their sources of origin. The attraction then of other heavenly bodies becomes a very real one. Another important reason for attempting to reach other spheres would be the search for raw materials. Our civilization today makes terrific demands on this world's resources of certain minerals, and two world wars has plundered the small stock ruthlessly, aggravating an already serious position. Materials like copper, tin, nickel, and zinc, just to mention a few, are rapidly becoming scarce metals. Remove these from the world today and about two-thirds of the things that make our way of life possible will disappear. It just won't bear thinking about. If, therefore, we are able to obtain these metals from a wasting body like the moon, then our civilization is assured for generations. There is also another reason which, although not very pleasant, is probably the one that will have most effect in producing positive results and that is that whoever can get to the moon first and establish themselves can hold the rest of the world to ransom since it is presumed to be a comparatively simple matter to launch disastrous missiles against this long-suffering world. Be that as it may, one thing seems certain and that is that the science of electronics is coming fast into its own.

For those who say that they can see no future in the radio industry, let them reflect that no other science is progressing with such gigantic strides. Every passing year opens up whole new avenues for research and employment in fields of wide and varied interest and there is no reason to suppose that space travel won't make even greater demands on those employed in electronics.

The PHILIPS Experimenter

An advertisement of Philips Electrical Industries of N.Z.,Ltd.

No 57: Super Selectivity Without Tears

In the last several issues of the Experimenter we went to considerable lengths to describe a system for producing the latest technical development in amateur radio for providing extra ether space without increasing the width of the amateur bands. We refer, of course, to single-sideband. The other approach to the same problem of crowded bands is one that has received considerable attention in the technical literature. It is the method of building receivers with greater and greater selectivity. While this approach has much to recommend it, it also has its drawbacks, especially for 'phone work, but many of the schemes for obtaining super selectivity have had obvious disadvantages on the purely constructional side. The time-honoured method, of course, is to use a crystal filter, but even with the advent of reasonably priced 455 kc/sec. crystals, this has not become as popular as might at one time have been expected. The reason is undoubtedly the fact that a crystal filter leaves a good deal in the hands of the operator, and is virtually useless if he is unskilled. Nor is a crystal filter the easiest thing to install in an existing receiver without a good deal of trouble, or even to insert into a conventionally designed I.F. channel. As a counter to these difficulties, we have seen such things as multi-stage I.F. amplifiers with back-to-back I.F. transformers between each pair of valves, double conversion receivers with the final I.F. on anything from 100 to 50 kc/sec., and so on. These things do work—there is no doubt of that—but in spite of their complexity they do not approach the crystal in selectivity, and are much more expensive in parts even than the crystal filter. They do have the virtue, however, that they are easy to align and operate, but against that, they all give only one degree of selectivity, and on the numerous occasions when less selectivity can not only be used, but is actually desired, they lose out badly because of their non-adjustable nature. The ideal super-selectivity scheme woud have some, and preferably all of the following characteristics:—

(1) Continuously variable control over the bandwidth.

(2) Small or negligible change of overall gain as the selectivity is varied.

(3) Non-critical alignment.

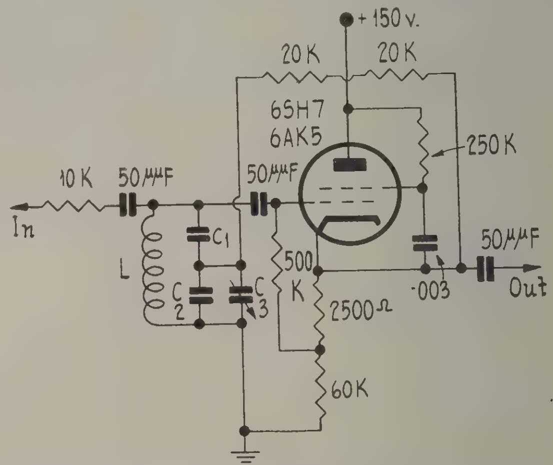
(4) Negligible de-tuning effect as the selectivity control is varied.

(5) Ability to be used for both 'phone and C.W. reception.

The scheme we are about to propound complies absolutely with (1), (4), and (5), but only partially with (2) and (3), but its characteristics are such that it is perhaps the best means yet developed for obtaining extreme, yet controllable selectivity. It is not original, but was first described by H. E. Harris, in *Electronics* of May, 1951, and has been applied to the purpose in hand by Rudkin, writing in *Amateur Radio,* March, 1952. The circuit recommended by the latter is shown in Fig. 1.

BASIC CIRCUIT

From Fig. 1 it can be seen that the arrangement consists of a cathode-follower, fed from a circuit tuned to the intermediate frequency. The tuning condenser of this circuit is split into two condensers in series, each having approximately twice the normal capacity, so that the series combination has a capacity equal to the usual tuning capacity for the coil used. From the output terminal, which, of course, is the valve's cathode, signal is fed back to the junction of the two condensers. The proportion of the output voltage fed back is determined



Circuit given by Rudkin, illustrating the basic idea of the super-selective stage. Our own improved version uses a Philips EF42, connected as a triode, and rather different circuit constants.

by the size of the feedback resistor, so that by making part of this variable, the degree of feedback is readily controlled from the front panel. Now the output voltage of a cathode follower is in phase with the input voltage, and so is in the correct relationship to it to give positive feedback. But the output voltage is also less than the input voltage by a small amount, so that unless some means is found of increasing the feedback voltage, it will not be possible to effect a very great increase in the Q of the tuned circuit. However, with the connection shown, the input circuit acts towards the feedback voltage as a step-up transformer, making it possible for the effective feedback voltage at the grid of the valve to become greater than the input voltage. Needless to say, under these conditions, the whole affair oscillates, which is not quite what is wanted, but it does show that enough regeneration *can* be had to cause a very large increase in the Q of the circuit, and therefore in its selectivity.

At this point, it might well be asked whether this is not just another way of making a regenerative I.F. stage, and whether the same result might not be obtained simply by using a more conventional regenerative amplifier circuit. The answer to this is not simple. The stage is undoubtedly a regenerative amplifier, but with several very important differences. In the first place, there is no amplification in the valve itself. This is most important, because it accounts for the great stability of the circuit, without which any amount of regeneration is quite useless. Measurements of the finished article disclose that it raises the effective Q of the tuned circuit to almost unbelievable values—values at which practically any other arrangement would be so unstable as to be quite useless. The gain of the arrangement exists solely in the fact that the Q of the tuned circuit has been raised, increasing the voltage which it develops across itself, at the same time as it increases the selectivity. In any arrangement in which feedback is used to increase the selectivity and gain of a tuned circuit, some means must be provided of varying the amount of feedback. Schemes have been invented, and used, in which balanced positive and negative feedback round a two-stage resistance-coupled amplifier provide a high degree of net negative feedback at all frequencies off resonance, and a net feedback of zero at the resonant frequency. These circuits are quite practical, but they are difficult to adjust satisfactorily, because the high gain of the two-stage amplifier makes the resistors of the feedback chain very high in value—of the order of 20 megohms or more. As can be imagined, the adjustment of such a feedback resistor to the point where a given, critical amount of feedback is obtained, is a very tricky business. Here, on the other hand, the feedback resistor, in the most selective position of the control, is not much greater than 20,000 ohms, and this makes the whole thing much less critical both in adjustment and in operation. There is no difficulty at all with this circuit in making the Q and selectivity of the input circuit only as high as that of the winding itself, simply by increasing the value of the feedback resistor, and in this condition, the bandwidth of the whole I.F. channel is only that of its normal I.F. transformers. It can be seen, therefore, that covering the whole range of selectivity between that normal to a single 455 kc/sec. I.F. stage and the super-selectivity that can be achieved if one wishes, is merely a matter of choosing for the feedback resistor a suitable proportion between the fixed and variable portions, and a particular value for the fixed portion. If desired, the values can be chosen so that very high selectivity, but rather less than the maximum possible, is obtained with the control wound right up. Alternatively, the resistors can be chosen in such a manner that the control allows the circuit to be brought right up to the oscillation point. Which method of adjustment is used will depend solely on the use to which the receiver is to be put. For mainly 'phone work, the former is recommended, since the maximum selectivity available is so great as to render phone signals virtually unreadable. For C.W., no harm will be done if the feedback resistors allow the stage to go into oscillation at the end of the control, for the quite staggering selectivity obtainable just below the oscillation point is most beneficial for this work. However, for those who like to avoid critical adjustments altogether, the feedback can be arranged so that the oscillation point is not quite reached, after which the selectivity is even further supplemented by the use of an audio frequency filter, tuned to some convenient frequency, like 500 or 1000 cycles.

VARIATIONS OF THE BASIC ARRANGEMENT

It will be noticed that the input voltage is applied, not directly to the tuned circuit, but via a series combination of capacity and resistance. The purpose of this might be rather puzzling. A very obvious method of exciting the circuit would be to make the tuned circuit the secondary of an ordinary I.F. transformer, and rely on the inductive coupling from the primary for injection of the signal. This, however, would not be a good plan. As is well known, complications occur in the tuning of a transformer if the coupling between the windings is greater than a certain amount. This is the point of critical coupling, and all couplings greater than this produce a response curve for the transformer that exhibits two peaks instead of one. Now the value of this coupling is carefully organized in an ordinary I.F. transformer, in relation to the Q of the windings, which, incidentally, determines how much coupling may be employed before the critical value is reached. With our present arrangement, however, we are messing about with the Q of windings in a way that was hardly envisaged by the designer of the I.F. transformer, and the result is that as soon as our super-selectivity comes into operation, the coupling immediately becomes much greater than critical, and the double-peaking phenomenon appears. This has no place in a circuit where we are after only one peak, and that of more than usual sharpness, and the attempt to feed the circuit in this way would result in something that was impossible to align properly.

The best place for the circuit is immediately following the mixer stage, and before the normal I.F. stage. In order to get rid of coupling difficulties, and in order also to preserve normal operating conditions for the mixer valve, the best way to tackle the problem is to use a conventional transformer in the plate circuit of the mixer, and couple the secondary of this transformer to the circuit of Fig. 1. When this is done, the high resistance in series limits the coupling between the cathode follower input circuit and the secondary of the transformer to a value that is less than critical, so that double-humping is avoided.

The output is taken from the cathode terminal, as shown, and the simplest and most satisfactory way is to use a grid leak for the following amplifier, and connect the coupling condenser directly to the grid. The amplifier is then quite conventional, with an ordinary transformer in the plate circuit, feeding any desired arrangement of diodes for detection and A.V.C.

In Part II of this article, we will give the circuit of a complete I.F. channel built along these lines, and incorporating a further feature that many C.W. enthusiasts have asked us to describe in these pages, namely an audio frequency filter circuit, tuned to a suitable frequency for C.W. reception. The valve line-up has a Philips EF42 as the cathode-follower super-selective stage, followed by a Philips EF41 as a conventional I.F. stage, and a Philips EB41 for detection and A.V.C. Then comes the special audio filter, using Philips Ferroxcube pot-type iron-cored coils, which make the required inductances easy to obtain with the minimum amount of trouble to the constructor, and a Philips EF41, triode-connected as an audio frequency amplifier, for headphone reception, or for feeding to a power output stage or audio amplifier.

PERFORMANCE OF THE CIRCUIT

The circuit mentioned in the last paragraph has been built in our laboratory, and has given an excellent

(Continued on Page 48.)

New Zealand Radio Traders' Federation

A very successful Annual Conference was held this year at Dunedin on 14th and 15th May. Amongst those present were: Mr. J. Fairclough, President; Mr. D. Chew, of Wanganui; Mr. J. D. Campbell, of Southland; Messrs. D. B. Billing, N. Souper, J. Burns, W. Young, and J. S. Oxley, of Wellington; Messrs. A. J. Howorth, M. M. Gillick, J. T. Mitchell, T. R. McGregor, K. Bassett, J. P. Pickerill, H. J. Hayward, A. Jones, A. McCarthy, and M. Cook, of Otago; and Mr. H. C. Osborn acting for the Secretary.

Much valuable business was transacted under the able chairmanship of Mr. John Fairclough, supported by Mr. H. C. Osborn, Secretary of the Otago Association, deputizing for Mr. P. Luxford, who was unavoidably absent through pressure of duties in Wellington.

In his opening remarks, Mr. Fairclough expressed his pleasure at the venue of the Conference, and Mr. M. M. Gillick, President of the Otago Branch, extended a hospitable welcome.

The appointments of the following proxies were approved:—

Mr. J. Burns, for Napier; Mr. D. Chew, for Manawatu; Mr. W. Young, for North Island Minor Associations.

After the confirmation of the minutes of the previous annual meeting held at the Chateau Tongariro in April, 1951, matters arising therefrom were discussed, including the position of battery supplies, stolen radios, etc. It was reported that many efforts had been made to arrive at a standard guarantee, but, owing to the non-co-operative tactics of one large manufacturer, the Federation's endeavours had proved fruitless.

Finance

The Annual Report and Financial Statement were adopted unanimously, but some discussion ensued over the secretarial fee and future finances, which will have the attention of the incoming committee.

Advertising

Appreciation was expressed to Messrs. Radio and Electronics (N.Z.), Ltd., for their publicity and advertising services. It was also suggested that direct mail should be used to further the purposes of the Provincial Associations, but finally, the future policy of publicity was left to the incoming Executive.

Official Organ

Radio and Electronics was once again appointed the official organ of the New Zealand Radio Traders' Association.

Federation Badge

Samples were submitted of two proposals for a Federation Badge, and finally the quotation of the Radiant Transfer Manufacturing Co., Ltd., was accepted, with the provisos that the size should be reduced by 1 in. in diameter, and the words "sales and service" be replaced by "dealer."

REMITS

Household Appliances

"In view of the extension of the Radio Traders' business today, covering the majority of household electrical appliances such as washing machines, vacuum cleaners, refrigerators, sewing machines, etc., that the ramifications of the New Zealand Radio Traders' Federation should include such actions as may from time to time be necessary for the protection of those lines for the retail trade."

In explanation, Mr. Fairclough pointed out that there appeared to be no genuine radio trader who lived by radio trading alone, and that most radio traders were vitally concerned with the sale of articles enumerated in the motion.

Seconding the remit, Mr. J. Campbell mentioned Southland's vital interest in this matter, for its members had been known to travel 80 miles to service refrigerators gratuitously. The adoption of such a remit would improve chances of increased membership.

After the reading of relative correspondence from the New Zealand Retailers' Federation, Mr. Jones suggested that members should ascertain the best authority to guard the interests of resellers of these articles. He considered this to be the New Zealand Retailers' Federation, which, incidentally, had been the only body to appear before the Board of Trade.

Mr. Billing remarked that there was already some considerable confusion regarding the appropriate authority, for in the past, the electrical traders have watched the interests of retailers of the defined articles. It seemed, however, that the electrical traders had endeavoured to preclude radio traders from membership of their organization. The adoption of this remit would mean that such a retailer could be represented by three voices.

After some deliberation, it was finally resolved: "That the incoming Executive give urgent consideration to the remit."

Trade-in Booklet

In moving the remit, "That a new edition of the Trade-in Handbook should be published, but when determining values, a more realistic approach should be made," Mr. Young contended that, if a set was in good working order, a minimum of £1 should be allowed.

Seconding the motion, Mr. Chew considered that maximum and minimum values should be established, and tabled to Conference Wanganui's schedule of trade-in values.

Members were warned by Mr. Souper of the surplus of 500 books already held by the Federation. He considered that members should ensure that all their sales personnel possessed a copy, and that Associations should also distribute copies to non-members, thereby demonstrating the benefits of the Association. Members should also ascertain whether there were enough new sets to justify a reprint.

Finally the remit was adopted unanimously.

Financial Year

The following remit was carried unanimously:

"That all Associations affiliated to the Federation should have a uniform date for the end of their financial years." (Note to remit: 31st March is suggested.)

Bulletin

It was resolved: "That a bulletin containing items of general interest be issued periodically, and that it be sent by the Federation to all members of affiliated Associations."

Nominal Roll

The meeting unanimously adopted the remit "That all Associations when making their declarations of membership to the Federation, shall at the same time advise the names and addresses of their members."

Radio Survey

The following remit was adopted:

"That the Federation express its willingness, in principle, to consider sharing in the cost of the market research proposal formulated at the instruction of the New Zealand Radio and Television Manufacturers' Federation by the Goldberg Advertising Agency."

Members spoke freely on this subject, Mr. Burns, the mover, pointing out that manufacturers were interested from a potential market viewpoint. Further, such information concerning the average age of sets, the amount of servicing required for each set, etc., was extremely useful. This proposal would necessitate a careful screening of selected panels of householders, but, while the costs could easily be in excess of £1,000, it was necessary for this Conference to adopt the scheme in principle only.

Mr. Souper intimated that a similar survey had proved successful to within a margin of 3 per cent. of error, but Mr. Chew pointed out that the results could be nullified with a change of trading conditions. Mr. Pickerill instanced the results of a survey made by his own firm, which showed that 50 per cent. of its clientele owned sets in excess of 15 years of age. Stressing that the project was well worthy of the Executive's attention, for no individual could be successful in business without a full and comprehensive knowledge of the market, Mr. Billing suggested that £250, or one-third of the cost of the project, would be a wise investment. In closing the discussion, however, Mr. Burns pointed out that no concrete proposal was before the Federation. His remit had requested an expression of support in principle only.

Three-pin Plugs

With regard to this remit, Mr. Chew intimated that retailers were prepared to pay the additional costs, and this procedure would facilitate sales. This matter had been discussed by the manufacturers, and Mr. Souper pointed out the danger of damage in transit. Further, on account of some firms not having the requisite licensed personnel, it was likely that some difficulties could be experienced with the Labour Department.

In support of this, Mr. Campbell said that his firm's sales required at least 95 per cent. of these three-pin plugs.

Finally, the following remit was adopted: "That three-pin plugs be fixed to radios and appliances with the exception of bed lamps, before the articles leave the factory."

Additional Flex

In adopting the following remit, the Conference agreed to incorporate Mr. Burns's suggestion that a manufacturer's reputation would be enhanced if some consideration could be given to left-handed users of such appliances as irons, etc.

"That reasonable lengths of flex be fixed at extra cost to the retailer, before the appliances leave the factory."

This concluded the remits.

Radio Interference

Radio interference is of paramount importance in Otago, and, in conjunction with Messrs. Billing and Souper, the President had called on some Otago technical members of the radio trade. It was agreed that:

"The incoming Executive, in particular conjunction with Mr. Billing, should make radio interference a matter of importance in forthcoming bulletins."

Though the trouble is foreign to Southland, the matter of radio interference caused by fluorescent lighting was discussed, and emphasis laid on the necessity for eradicating this trouble prior to the introduction of television. It was contended that some technical difficulty of unknown origin emanates from within the tubes themselves, though innumerable cases were instanced of the reversing of the tubes solving radio interference. Questions were also asked why manufacturers should have to fit suppresors to all fittings, when 90 per cent. could be proved to be free from the fault of radio interference.

The Otago difficulty relating to the frequencies of stations 4YA and 4YC was discussed fully, and it was finally resolved:

"That Federation puts before the Broadcasting Board a strong appeal for something to obviate the trouble."

Television

During the full discussion on this subject, the vital importance of technical training was emphasized, and it was deplored that some organizations were endeavouring to have this abandoned.

In Mr. Burns's opinion, technical training was divided into two parts: (1) Radio training; (2) Research.

It was essential, he contended, that radio training should be so advanced that the next step to television would automatically follow. With regard to research, he considered that Canterbury College led the Dominion in training research, the three recognized television experts being Drs. McLeod and Elliott, and Mr. Wilson.

Attention was drawn to the fact that the introduction of television would also employ semi and unskilled labour, such as steeplejacks, steel workers, and labourers.

Finally it was resolved: "That this Conference instructs the Executive to give urgent attention to provisions in technical colleges for adequate training in radio and television training, and to co-operate with other organizations in approaches to the Government."

The necessity for proceeding with the production of television brochure was strongly emphasized, and it was agreed: "That Conference instructs the incoming Executive to proceed forthwith with the publication of a brochure on television."

Supply Position

Though manufacturers had produced more speakers last year than previously, and Philips Electrical Industries of N.Z., Ltd., had released a number to the trade, the lack of speakers caused great concern to radio dealers, and the poor supply of magnets had not assisted matters. An assurance had been received from Australia, however, that some improvement might be expected. The chairman complimented Swan

Electric Co., Ltd., for not opposing the move to secure import licences for speakers.

With regard to the supply of valves, it was considered that the trade was in a better position now than 12 months ago, but this could deteriorate very quickly due to present restrictions on dollar imports.

Attention was drawn to Wanganui's remit last year re the cancellation of 2.5 valves, but members agreed that restrictions in this respect could be dangerous.

Finally, it was agreed: "That the incoming Executive take immediate steps to bring to the attention of the Government Departments concerned, the fact that while dollar licences issued in 1951 (and to a large extent used) have partially met current replacement demands for valve types not available from sterling sources, further dollar licences are therefore urgently required to meet immediate and future requirements."

ELECTION OF OFFICERS

The election of officers resulted as follows:—
President: Mr. N. Souper.

Vice-President: Mr. J. Howorth.

Executive: North Island Minor Associations: Mr. D. Chew; South Island Minor Associations: Mr. Griffiths; Major Association representatives: To be appointed by Associations.

Auditor: Mr. Gordon Berry.

Secretary-Treasurer: Office of the New Zealand Employers' Federation re-elected.

The following resolution was unanimously adopted:

"That Associations outside Wellington be advised to appoint permanent Wellington proxies to enable urgent meetings, if required, to be conveniently held. The proxies would automatically stand down when genuine representatives were present, but the proxy holder would be requested, for the sake of continuity, to be present holding a listening brief." ...

Tributes were paid to the retiring President, Mr. J. Fairclough, who suitably thanked members for their co-operation during his term of office. It was unanimously agreed: "That this Conference place on record its sincere appreciation of the services rendered to the Federation by Mr. J. Fairclough, and further, that Federation is conscious of Mr. Fairclough's attitude which had been service before self."

Next Conference

The venue and date of the next Conference was left to the Executive to decide, with preference to Canterbury or Auckland, whichever Association showed the greater interest.

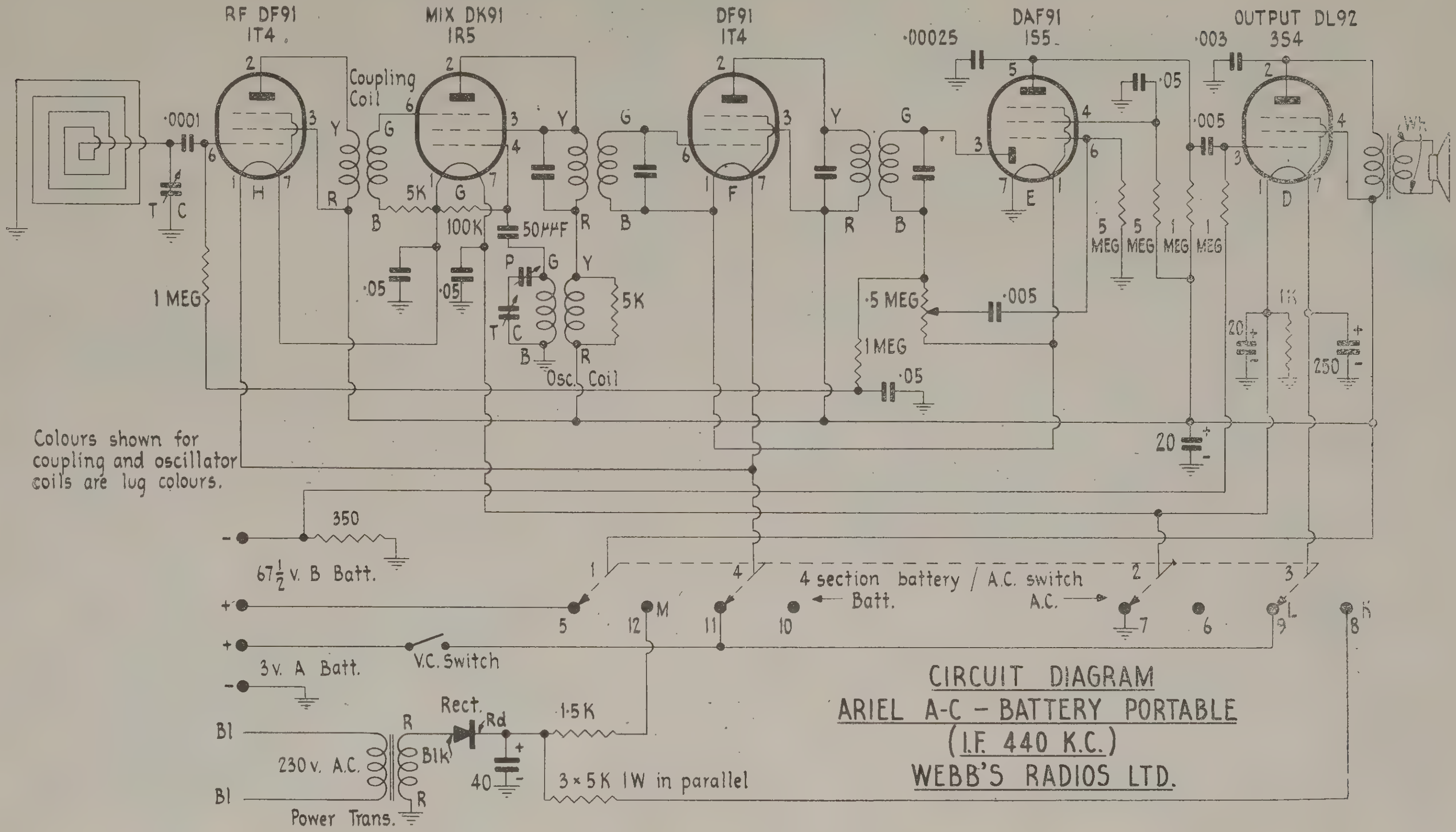
Liaison

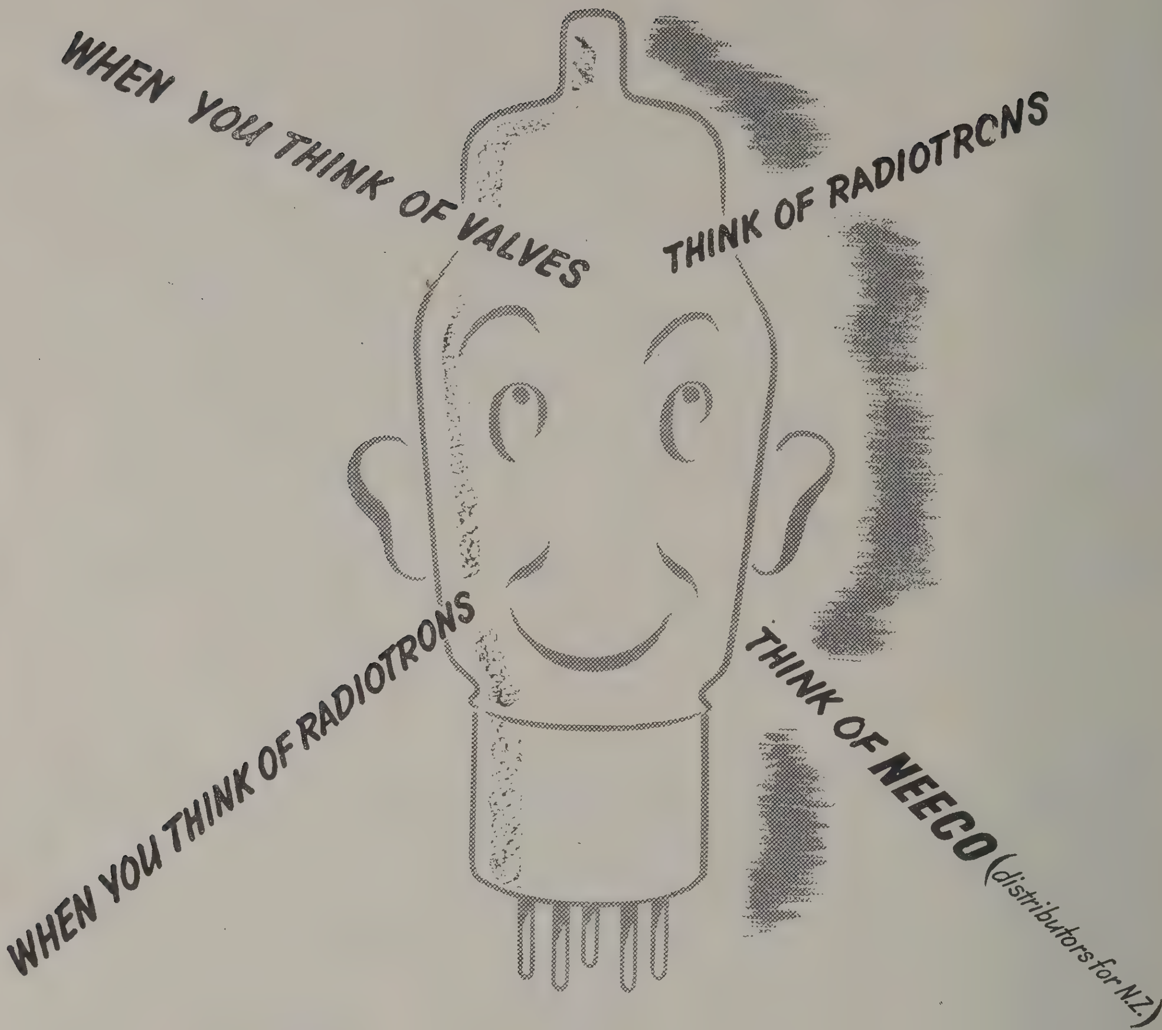
The question was raised concerning liaison between dealers and manufacturers, interest on the part of dealers having been noticeably lacking. Manufacturers' representatives present assured the Conference of their support in the matter of closer liaison.

The meeting concluded at 12.45 p.m. on 15th May with expressions of thanks to the Secretary of the Otago Employers' Association for the use of the offices and typing facilities, etc.

FOR THE SERVICEMAN—The "Ariel" A.C./Battery Plastic Portable

Note: The connection between pin 3 of the 1R5 to Y on the I.F. transformer is in correct. Pin 3 should be connected to R on the same winding.





When you need stocks of Radiotrons, you're sure of prompt service from your nearest NEECO branch. NEECO are New Zealand agents for Radiotrons . . . the valves that have set the world standard for long life and reliability. Types for so long in short supply are now arriving from U.S.A. At all times, NEECO are at your service for advice on any technical problems.

THE
NATIONAL NEECO ELECTRICAL
AND ENGINEERING COMPANY LIMITED

Auckland Wellington Christchurch Dunedin Hamilton Wanganui Hastings Invercargill

Book Reviews

"Application of the Electron Valve in Radio Receivers and Amplifiers," Volume 2 (Audio Frequency Amplification—the Output Stage—Power Supply).

This volume is the second of the trilogy being produced by the Philips organization in Holland, and distributed in New Zealand by Philips Electrical Industries of New Zealand, Ltd. The first volume has already been produced, and has been given an enthusiastic reception by the technical press all over the world. The present volume covers audio amplification and power supply, and so will be of interest to large numbers of those engaged in radio and electronic work. The treatment of the power amplifier stage is exceedingly comprehensive, and is approached from an entirely different standpoint from most theoretical dissertations on the subject, starting with an assumption of ideal characteristics for the valve. On this basis, the optimum operating conditions for the valve are deduced, after which the effects of curvature of the characteristics are related to the treatment for the theoretically perfect valve, to give a picture of the performance of actual valves. In a later section, the effect of the reactive nature of the load is taken into account. In a further section the practical matters of screen dissipation in tetrodes and pentodes, the effcts of actual output transformer characteristics, and the provision of grid bias, and other things are brought into the picture, and are in turn related to the previously made calculations of maximum power output, distortion, etc.

The complete process outlined above, is carried out for single-ended triode and pentode stages, and for push-pull stages, triode and pentode, for all classes of operation from Class A to Class B_2. It is no exaggeration to say that this is without doubt the most comprehensive treatment of this subject that this reviewer has ever seen.

In view of the above, it is all the more surprising to find that the section devoted to voltage amplifiers is, by comparison, extremely sketchy. Likewise, the space devoted to the whole range of resistance-capacity-coupled circuitry, which has such great importance today, is remarkably small. For instance, only the briefest reference is made to phase inversion circuits, other than a few unusual arrangements which do not seem to have attained any sort of prominence except in Philips literature. In spite of the excellent treatment of power output stages, and notwithstanding the presence of a great deal of useful design data, the book has an unbalanced air about it. The proverbial reader from another planet would be forgiven if, after reading the book, he gained the impression that audio amplification comprised an output power amplifier, with, very occasionally, another valve ahead of it.

There is no mention of the multitude of problems connected with high-quality reproduction, and of their effect on amplifier design. Indeed, there is not a single example of a complete amplifier circuit, in spite of the fact that amplifiers figure in the title.

However, some of these omissions will probably be rectified in the third book of the series, which is now in course of preparation. This book, it is stated, will

cover negative feedback, contrast expansion, A.V.C., and A.F.C., and other matters not so far dealt with in the series.

The above criticisms should not be interpreted as detracting in any way from the excellence of the material that has been included in this volume. Indeed, the book forms a worthy successor to the excellent first part covering the design of the R.F. end of the receiver, and there is no doubt that its remarkable treatment of power output stages makes it particularly valuable to the radio engineer.

"Transmitting Valves," by Ir. J. P. Heyboer and Ir. P. Zijlstra. Published by Philips, Holland; distributed in New Zealand by Philips Electrical Industries of New Zealand, Ltd.

It is surprising how few books there are devoted solely to transmitting valves and their circuits. Indeed, off-hand, the writer cannot name another. This volume is thus a very welcome addition to the literature of valves, and one which those concerned with transmitting will find essential in their libraries. After introductory chapters describing the construction and materials used for transmitting valves, and the reasons behind these things, the book goes on to treat in a most comprehensive way, the triode as an R.F. power amplifier, the tetrode and pentode in the same role, the various methods of modulation, oscillator circuits using transmitting valves, frequency multipliers, V.H.F. valves and circuits, and a number of special aspects of transmitting valves that usually get very brief mention ,if any, in most text-books. The treatment is partly mathematical, but those who are not keen on mathematics will still find the book very useful, as the conclusions drawn from the mathematical sections are very clearly presented and interpreted in terms of practical results.

* * *

"Radio Circuits"—Step by Step Survey of Superhet Receivers, by W. E. Miller, M.A. (Cantab.), M.Brit.I.R.E. Publishers, Iliffe's, London.

This is the third edition of a book which has helped a great many beginners to gain a full understanding of the working of modern radio receivers. It is a progressive explanation of the superheterodyne receiver, and the principle adopted by the author is that of taking the individual circuits of the receiver, one after the other, and explaining each in detail. The text is quite comprehensive, and has been brought well up to date, with discussions of the latest types of dry-battery operated portables, A.C./D.C./Battery portables, bandspreading, automatic tuning, etcetera. The descriptions are completely non-mathematical, and require very little indeed in the way of preliminary knowledge on the part of the reader. A good feature of the work is that examples are given of obsolescent circuits, such as the autodyne oscillator-mixer, so that the learner is not left without some knowledge of circuits found in older receivers.

Under the thirty-two headings which make up the 118 pages of the book, a brief mention is given to almost every aspect of the normal commercial receiver, but in the reviewer's opinion, the book could be greatly improved by rather more explanation by the author of the purely practical points arising from the material he has already provided. For example, while there is a very brief treatment of the necessity for padding circuits in order to track the oscillator with the signal circuits, the author entirely omits to mention the alignment process itself. It seems unlikely that even a beginner would be so incurious as to be satisfied with the somewhat meagre details that are provided in many places. However, as the beginner's initial introduction to the suerheterodyne, the book should fill a very useful place in the literature, and the author probably argues that the best place for more detailed information is in other texts, which can be tackled after his very digestible first meal has been assimilated.

The Plessey Nyquist Diagram Plotter

In the development and production of a servo-mechanism it is frequently necessary to find the response of the system, or of its component parts, to sine-waves of various frequencies. The response may be recorded in various ways, one of the most useful of which is the Nyquist diagram; this is a polar plot of the locus of the vector which represents, in amplitude and phase, the transmission of the apparatus under test. When the test frequency is varied from zero to infinity the tip of the vector traces out a curve which forms the diagram, and means must be provided for indicating (at least approximately) the frequency to which any point on the curve corresponds.

In the research laboratory it is customary to assemble an array of instruments (oscillator, cathode-ray oscilloscope, attenuators, etc.) from which a skilled technician can, after some laborious point-by-point plotting, produce the required Nyquist diagram. Sometimes, in addition, rotating mechanical devices are used which may limit the range of the equipment to quite low frequencies; and the measurement of phase at very low frequencies by oscilloscopic methods is, in any case, difficult. Apart from eliminating the tying-up of much expensive equipment which could be usefully employed elsewhere, there is a need for a piece of apparatus which can be used by comparatively unskilled people for the routine testing of production servo components.

The Plessey Nyquist Diagram Plotter, developed in connection with a Ministry of Supply contract, has been designed primarily for this purpose, and enables a permanent record of the frequency response to be obtained quickly and accurately, but without the use of much technical knowledge on the part of the operator.

The principle of operation of the Plotter may be seen by reference to the block diagram. An oscillator provides a variable frequency signal to drive the apparatus under test, the rate at which the frequency is varied being automatically adjusted to suit the prevailing conditions. A second output from the oscillator feeds a phase-shifter which is mechanically coupled to the turntable on which a polar chart is carried. The output from the apparatus under test returns into the Plotter, and passes through a variable-gain amplifier whose gain-control is mechanically coupled to a pen which moves radially over the chart. For a given oscillator frequency the phase-shifter output is of constant amplitude but variable phase, whereas the variable gain amplifier output is of variable amplitude but constant phase. By suitable adjustment of both gain and phase, the variable-gain amplifier output may be made to match exactly the phase-shifter output. These adjustments are automatically carried out by two motors, which are fed with signals proportional to the amplitude difference, and phase difference, respectively; in making the adjustments the motors also position the pen at the correct point on the chart.

Missing or Stolen Radios

The following reports have been received:—

Criminal Investigation Branch, Auckland Central:

Courier, broadcast model, brown bakelite cabinet, size about 12 in. x 8 in. x 8 in., A.C., on back of chassis name V. Dutton or initials V.B.D. scratched; serial number A.C. 109146.

Autocrat car radio, black crackle finish, aerial connection at base at right front, motor-cycle control wire nipple used in aerial connection. Aerial of this also stolen, ordinary telescopic type, chrome plated.

Motorola car radio, 6-volt, dial painted brown, speaker blue, square shaped, white plastic grille in front, serial number 3132 over G.

"National" 6-valve radio, dual-wave, A.C., model 126, mantel model, square dial, magic eye, wooden cabinet, serial number 1892.

Police Station, Newmarket:

"Pacemaker," yellowish cream colour, wooden frame covered with leather type cloth, five-valve, battery and electric, two bakelite control knobs situated on top and at each end of carrying handle. About 6 ft. flex with three-point plug attached.

Police Station, Lower Hutt:

"Philips" model 208, four-valve broadcast, mantel model, contained in brown plastic case with curved top, two white control knobs.

Police Station, Dunedin:

Home-made five-valve set, wooden case, 11 in. x 7 in. x 5 in., metal handle on top. Case painted white and finger marks on top of case prior to drying of paint.

Criminal Investigation Branch, Christchurch:

"Mullard" 5-valve, broadcast, green bakelite cabinet, circular dial with two white tuning knobs, one of which is loose.

Criminal Investigation Branch, Auckland:

"Emitron" H.M.V. car radio previously reported stolen now recovered.

R.C.A., made in U.S.A., 5-valve, dual-wave, long dial on top front with two white tuning knobs. Brown switch at back for dual wave, A.C./D.C. 110-volt transformer attached; 15 in. x 6 in. x 4 in. black bakelite case, serial number B.56905.

Criminal Investigation Branch, Christchurch:

"Philips" 5-valve mantel short-wave radio, 18 in. x 15 in., varnish finish, four tuning knobs, magic eye on left side, large dial right across set about 3 in. wide.

Six "Ekco" models U153, serial Nos. 2186, 3954, 3901, 3197, 2218, 3797, missing from s.s. *Rangitiki at* Lyttelton. Five valves, red cabinet, white speaker and dial, elliptical speaker, vertical pointer travelling horizontally; 3 black tuning knobs, 3 wave ranges; plastic moulded cabinet. Use on 200/250 volts, 40/100 c/sec. A.C. or 200/250 volts D.C.

Police Station, Masterton:

"Philips" 2-way, 6-valve portable. Brown leatherette case, Type No. 545, chassis No. 787.

Police Station, Newmarket:

"Lewis Eady" Serial No. 92591, white plastic case, mantel model, size 14 in. x 9 in. x 12 in., three control knobs, oblong shaped dial. Identifiable.

Criminal Investigation Branch, Auckland Central:

One "Aristocrat" car radio, made for Humber, 6-valve, size 16 in. x 8 in. x 5 in., radio and speaker in same container, three white knobs, brown dial with red pointer. Serial No. R.7363. Identifiable.

N.Z. Radio, Television, and Electrical Traders Association, Auckland:

R.C.A., serial No. B.56905, 5-valve dual-wave, long dial on top front with 2 white tuning knobs. Brown switch at back for dual-wave. A.C./D.C. 110-volt transformer attached. 15 in. x 6 in. x 4 in. black bakelite case.

Two "Ultimate" 6-valve personal portables, brown plastic case, two white tuning knobs and white plastic carrying strap on top. Size 9¾ in. x 6½ in. x 4½ in. Serial Nos. 143604, 143459.

N.Z. RADIO-TELEVISION AND ELECTRICAL TRADERS ASSOCIATION ANNUAL MEETING

Members are asked to note that the Annual General Meeting of the Association will be held on

TUESDAY, 22nd JULY, 1952, at 7.30 p.m.

in the

NATIONAL PARTY CENTRE ROOM,
ALSTON CHAMBERS,
QUEEN STREET, AUCKLAND.

Business:

(1) Election of Officers.
(2) Adoption of Rules.
(3) Incorporation of Association.

J. E. BEACHEN, *Secretary.*

TRADE WINDS

In the launching of Pye Radios on the New Zealand market, nothing has been left to chance. George Wooller and Bert Staff have just completed a round of visits to every Pye dealer in the country, giving them the "low-down" on the new models now being distributed and on the new publicity material available.

Born and educated in Wellington, Bert Staff has concentrated throughout his business career on the sales side of the radio and allied trades. In the course of this he has covered every district in New Zealand. Until his appointment as Sales Organizer of Pye a few months ago, Bert was a member of the staff of H. W. Clarke (N.Z.), Ltd., joining them in 1934. During the war he served overseas with the Second Echelon. Since 1947, he has deserted the "windy city" for the fair Auckland.

* * *

How the oldest established electrical business keeps up with the newest ideas is strikingly demonstrated by the new premises of Messrs. D. A. Morrison of Wanganui. Congratulations, Don.

First opened in front of "Everybodys" Theatre (now Messrs. Harmans), the business was later moved to the upper portion of the Avenue, and there for many years D. A. Morrison and Co. has undertaken all branches of electrical work.

* * *

Acting as hosts on behalf of their company, Messrs. H. W. Clarke (N.Z.), Ltd., Messrs. Neil Avery (Auckland Province), Lloyd Borthwick (Auckland City), Basil Clarkson (Middle North), Ernie Paulin (Wellington, Nelson, and Blenheim), Warwick Whelan (Christchurch and the Coast), and H. E. Thomas, Ltd. (the far South), have recently conducted Mr. Arthur Barry, Assistant Sales Manager of Tecnico, Ltd., Marrickville, N.S.W., Australia, on a tour of New Zealand. Mr. Barry was extremely impressed with New Zealand, especially our trees, but this did not deter him from burning the midnight oil with Ken Stephen, Sales Manager of H. W. Clarke (N.Z.), Ltd., discussing ways and means to further the Tecnico name and products on the market.

* * *

Recently awarded the M.B.E. for his services to marine radio, Mr. W. Davies, Radio Officer No. 1 to the Marconi International Marine Communication Co., Ltd., was the world's first official sea-going wireless operator, as they were then called. He has just completed his fiftieth year in the services of the Marconi Company, and is still at sea.

Commencing his career as a G.P.O. telegraphist at Holyhead, he answered an advertisement in 1902 for men to enter the new and still mysterious "wireless." At that time Marconi was in Cornwall, investigating the commercial possibilities of his successful transatlantic transmission from Poldhu. After training at the Lizard, Mr. Davies first went to sea on the Allan Line's *Parisian* in May, 1903, and later served on board the *Lusitania* for three trips, fortunately being transferred before her final disastrous voyage. He came through World War I unscathed, and also through the second World War—including D-Day at Arromanches. Among his ships have been the first *Mauretania,* the *Umbria,* the *Lucania, Doric, Celtic, Laurentic,* and the *Compania.*

* * *

A new Registered Trade Mark in New Zealand is "Ronette," No. 50982, class 9, dated 31st August, 1951, duration seven years, usual markings.

AN ACHIEVEMENT FOR BRITISH DESIGN

An export radio receiver, manufactured by Pye Limited of Cambridge, was chosen for the "Design from Britain" Exhibition held in Oslo, Norway, on 3rd May. Sponsored by the Society of Industrial Artists, the British Council and the Council of Industrial Design, the object of the exhibition was to boost the prestige of British goods by showing examples of good design and quality.

The radio receiver, Model "G" (Pye PE.39), presented in a beautifully moulded cabinet, with cream front and brown sides, tops, and knobs, is a striking example of British craftsmanship. As a receiver in the medium price range, it offers a very high standard of performance and reliability, and, being designed for world-wide reception, is "tropicalized" to withstand varying climates. It has six bandspread short-wave bands, as well as medium and medium short-waves.

* * *

Eight million miles of enamelled wire were produced by the Telecommunications Division of B.I.C.C. Ltd. (England), during 1951.

"SOME PEOPLE TALK GLIBLY"

Sir Alexander Roger, K.C.I.E., Chairman of Directors, British Insulating Callenders Cables, Ltd., speaking of personnel, in his report to the Annual General Meeting in June, 1952, said:

"During the year we opened our factories to visits from relatives and friends of employees. The response was most gratifying and I am confident such occasions go a long way to strengthening the "family" feeling

which has always been one of the outstandnig features of service with B.I.C.C.

"Some people talk glibly—and I believe often maliciously—about the 'two sides of industry.' There is no such thing in any successful company. Of necessity, some people hold a higher position or status than others, but unless all work in happy co-operation as part of the whole, appreciating the main objectives of the company, sharing in its difficulties and successes, no company will continue for long to be a successful one. And, as far as the higher positions are concerned—which what ever may have happened in the past can today only be held by men of merit—the way in B.I.C.C. is open to all. It is our proud boast that every senior executive and managerial position, and indeed most other senior positions in B.I.C.C., are held by men who have won their spurs in the service of the company much farther down the ladder."

R.E.C.M.F. EXHIBITION, 1952

P.T.F.E. Winding Wires

A revolutionary exhibit by British Insulated Callender's Cables, Ltd., at the R.E.C.M.F. Exhibition, Grosvenor House, London, from 7th to 9th April was P.T.F.E. (Polytetrafluoroethylene) winding wire with which can be wound coils capable of continuous operation at temperatures ranging from —75°C. to +250°C., although the maximum could be further increased for comparatively short periods of operation. The insulating film of P.T.F.E. is generally one thousandth of an inch thick.

From a mechanical viewpoint the present stage of development of the material necessitates care in the winding of coils. Successful experimental windings are, however, being produced by the Royal Aircraft Establishment.

Both production capacity and the raw materials required for its manufacture are extremely limited and application unfortunately must be confined at present to service requirements having the support of the Ministry of Supply.

Also to be shown is a wide range of P.T.F.E. insulated connecting wire and sleeving which is expected to be of considerable interest to manufacturers of miniature equipment, and for other applications where extremely high temperatures are likely to be encountered. The range of working temperatures is the same as for P.T.F.E. winding wires.

* * *

Acknowledgement is made to Messrs. Briscoe E. W. Mills and Co., Ltd., of receipt of a number of samples of varying types of solders, fluxes, and tinning compounds, made by Fry's Metal Foundries, Ltd., London, England. Literature also received covers a vast field of uses for these several productions ranging as they do from solder paint used for sweating in the assembling of cigarette lighters, metal toys, copper tubes, etc., an adherent coating paint for tinning as used for pre-tinning of automobile bodies prior to patching with solder—tinning of wash boilers, etc., a pure tin paint for use with food or cooking utensils, where lead cannot be used, a tinning compound containing solder and flux in powder form for penetration of oxide, rust, etc., and effective on metals which normally cannot be tinned easily, such as cast iron. For general soldering work there is a range of fluxes, fluids, and tinning salts and for radio and electrical work fluxes in the Alcho-Re series are available and which include a paste and a fluid flux both of which can be applied with stick or brush. There is also

available a cored solder wire with a continuous core of flux. From a perusal of the literature and an inspection of the samples it appears that Fry's have the answers to any soldering problem.

* * *

The preceding paragraph rather emphasizes the interest that manufacturers of solder are taking in the production problems of their customers. For instance, already we have the Ersin range of multi-cored solders for radio and electrical work, as well as the Du Bois tri-sol. Fry's Metal Foundries and the makers of Enthoven Superspeed special solder include in their ranges solders which leave a coloured trace on the joints as they are made. With all these excellent brands to choose from, there does not seem to be any reason why the New Zealand radio industry should ever experience any soldering difficulties.

WIRELESS AND ELECTRICAL TRADER YEAR BOOK 1952

Acknowledgment is made by *Radio and Electronics* of a complimentary copy of the *Wireless and Electrical Trader Year Book* (1952). Of this publication the publishers say:—

Since the *Wireless and Electrical Trader Year Book* was first published in 1925 it has become firmly established as the retailers' invaluable reference book to the radio and electrical industries.

In the 1952 edition, data of practical use to dealers in the new television areas and general reference and technical information have been carefully selected. Features include condensed specifications of current 1952 commercial television receivers (with such valuable facts as valves used, I.F. values, etc.) and information on valve and cathode-ray tube base connections, with over 200 valve base diagrams. These alone are invaluable to radio and TV service engineers.

A new feature, introduced in response to many requests, is a comprehensive list of the I.F. values of commercial radio receivers which have been marketed during the past five years. Other time-saving data ranges from specifications of current radio receivers, legal information and a directory of trade associations.

One of the principal aims of the *Year Book* is to assist traders to keep abreast of the constant changes in the names, addresses, telephone numbers and products of the firms engaged in the radio and electrical industries. These revisions have been incorporated in the directory sections, and the lists of names and addresses of firms therefore make the *Year Book* an invaluable and time-saving desk companion for every retailer and business man in the industry.

The *Wireless and Electrical Trader Year Book* will also prove of great assistance to overseas firms who are seeking contact with British suppliers.

Directory sections are printed on distinctively tinted papers for ease of reference.

Principal contents include: Directory of principal Trade Organizations—Legal and General Information—Radio Receiver I.F. Values—Television Information and Data— Valve Base Conections—Valve Base Diagrams—

PUBLICATIONS RECEIVED

Receiver Specifications of 1952 Models—Trade and Wholesalers' Addresses Proprietary Names Directory—Classified Buyers Guide.

* * *

Stress Analysis Equipment Catalogue—J. Langham Thompson, Ltd. (Electronic Controls and Appliances Ltd.).

Brochure, Electronic Measuring Instruments—Dawe Instruments Ltd. (Electronic Controls and Appliances, Ltd.).

Philips Bulletin, April-May, 1952—Philips Electrical Industries of N.Z., Ltd.).

A.P.A.E. Journal January/February, March, April, 1952—The Official Journal of the Association of Public Address Engineers (England).

Stock Record, May, 1952—Cory Wright and Salmon, Ltd.

G.E.C. Journal The General Electric Co., Ltd., of England, (British General Electric Co., Ltd.).

Sylvania News, March, 1952—Sylvania Electric Products, Ltd. (G. A. Wooller & Co., Ltd.).

Philips Technical Communications, Vols. 1949, 1950, 1951—Philips Electrical Industries of Australia Pty., Ltd. (Philips Electrical Industries of N.Z., Ltd.).

B.I.C.C. Annual Report for 1951—British Insulated Callenders Cables, Ltd.

Electronics Application Bulletins, February, March, April, May, June/July, 1951—N. V. Philips Gloeilampenfabrieken, Eindhoven, The Netherlands. (Philips Electrical Industries of N.Z., Ltd.).

Electronic Measuring, Vol. 3, No. 5—Philips Electrical Industries of N.Z., Ltd.).

Economic Survey, 1951—also Annual Report, 1951—Svenska Handelsbanken, Stockholm.

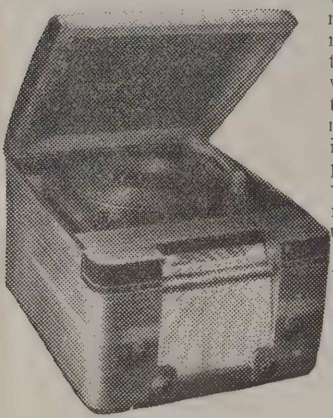
Westinghouse Engineer, May, 1952—Westinghouse Electric Corporation, U.S.A. (H. W. Clarke (N.Z.) Ltd.).

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

"CORNWALL" MODEL 525TRG
5-Valve Table Radiogram

This fine table model radiogram is the latest addition to the H.M.V. (N.Z.) Ltd. true-to-life radio range.



With the coming of the multi-speed recorded music this radiogram is the answer for those who wish to avail themselves of the new microgroove, long-playing discs. Being compact, the "Cornwall" will enhance any surroundings in which it is placed and will give performances equal to those of the larger console radiograms.

Valve Complement
(1) 7S7 Mixer
(2) 7B7 I.F. Amp.
(3) 7C6 Det. Audio. Amp.
(4) 7C5 Output
(5) 7Y4 Rectifier.

Frequency
Broadcast, 550 kc/sec. to 1500 kc/sec.
I.F.'s, 455 kc/sec.

Power
230 volts, 60 watts.

Measurements
Height, 12¼ in.; width, 16 in.; depth, 18¼ in.

Gram Unit
Three-speed B.S.R. single playing auto unit.

ULTIMATE RECORD-PLAYING UNIT
(By Radio (1936) Ltd.)

The Ultimate record unit as illustrated is a very modestly priced instrument for those who want a record player as a separate unit from their radio. It will take either 10 in. or 12 in. records and is housed in a compact, solidly constructed cabinet of selected Bulldog ply with an interior finish of sprayed brown flock.

The Ultimate record-playing unit has a type "S" Garrard single player with automatic cut-off and standard magnetic head.

The Ultimate record-player is complete with pick-up jacks to plug into any radio chassis fitted for separate gramophone use. Also included in the turntable is a handy needle well.

The cabinet is walnut finished and polished to give a hard-wearing surface.

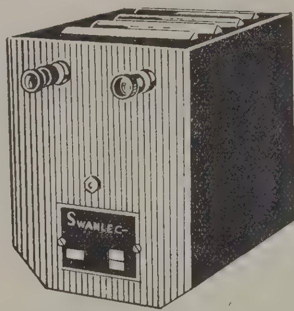
Overall dimensions are:—15⅛ in. wide; 14½ in. deep; 7¼ in. high.

This is an excellent accessory to any radio and represents wonderful value at a very reasonable price. Price £13 16s.

Orders may be placed now for immediate delivery.

SWANLEC CHARGER

The Swan Electric Co., Ltd., announce a new range of battery chargers suitable for home use.



The Swanlec charger is a sturdy, and attractive piece of merchandise, essential to every vehicle owner and indispensable in conjunction with home lighting sets. A dry plate selenium rectifier is incorporated and each is fitted with a fuse for overload and short circuit protection.

The chargers are cartoned ready for use from 230-volt A.C. mains, carry a factory guarantee, and are available from stock at highly competitive prices in 6 volts at 1, 2, and 4 amps, 12 volts at 1 and 2 amps, and also in a most useful dual range of 6 and 12 volts at 2 amps.

NEW VALVES IN THE PHILIPS RANGE

Philips anounce the following new arrivals in electronic tubes, all of which are now available from stock.

EF43—an H.F. Pentode with Variable Slope for Broadband Amplifiers

The new all-glass Rimlock tube EF43 has a maximum slope of 6.3 mA/V, and an equivalent noise resistance of only 2500 ohms. Control grid voltage is —2 to —30, input and output capacity 9.5 pF and 4.5 pF respectively. This is a new tube with a very wide field of application.

PB 1/150

The tube PB 1/150 is a direct equivalent of the American type 828. Our own tests indicate that the PB 1/150 is even better than the 828.

PL435

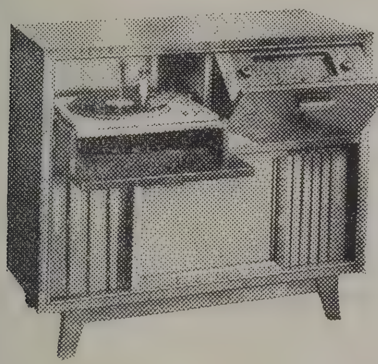
The PL435 is a hydrogen thyratron suitable for switching in line modulator circuits of microwave radar sys-

tems, in welding timing circuits and pulse communication systems, for use in induction heating and control circuits and for shock excitation of tuned circuits.

The short de-ionization time makes the tube especially suitable for pulsing service at very high repetition frequencies, at high peak currents and high voltages (90 A max. and 8 KV max. with a duty cycle of 0.0014 max.).

Further information is available from Philips Electrical Industries of New Zealand Limited, P.O. Box 2097, Wellington.

"PACIFIC" AND "REGENT" MODEL 8PE



The "Pacific" and "Regent" 8PE, produced at the Waihi fatcory of Akrad Radio Corporation, Ltd., is a three-speed, automatic changer radio gramophone. The three-speed automatic record-changer is a high-quality English product designed for accurate reproduction of long-playing $33\frac{1}{3}$ and 45 r.p.m. discs as well as the old type standard 78 r.p.m. recordings. The change-over from microgroove to standard discs is simply effected with interchangeable plug-in heads; each head is designed for the best possible reproduction of the different types of disc.

The whole gramophone unit is carefully spring-mounted in the cabinet to ensure silent operation.

The receiver of model 8PE is 8-valve push-pull dual-wave A.C. operated. The valves used are English loktal base types with the exception of the rectifier, which is the well-known 4-pin 5Y3. Great attention has been given to the design of the circuit associated with each valve so that stability and high performance are obtained.

The circuit of this receiver is quite conventional up to the audio section. In the audio section an ECH21 is used for the first audio amplifier and phase inverter. The five controls are: Tuning control; volume control; wave-band switch; treble control and on/off switch; and bass boost switch, the position of each being clearly marked on the dial. Both the dial and controls are mounted on a panel that tilts out at the front of the receiver so that they are at finger-tip height and the dial is easily read.

The frequencies of the two wave bands are:

Broadcast: 1500–500 kilocycles.
Short-wave: 6–20 megacycles.

These are marked on the dial in addition to New Zealand stations on the broadcast band and the international short-wave broadcast bands.

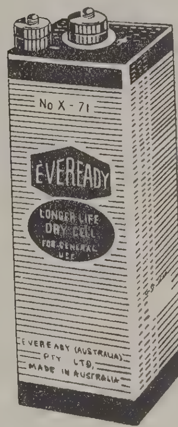
The design of the cabinet housing of the 8PE follows the modern American trend as can be seen from the illustration above. The top half of the cabinet at the front is made up of two doors hinged at the bottom. The right-hand door tilts out to expose the radio unit; the left-hand door in tilting out operates a slide which draws the automatic record-changer unit forward so that the turntable is exposed to facilitate record changing

On either side of the 12 in. speaker at the bottom of the cabinet there are record compartments. These compartments are without doors, and special matching record albums are available.

The dimensions of the model 8PE are $33\frac{1}{2}$ in. high, $37\frac{1}{2}$ in. wide, 15 in. front to back.

The "Pacific" and "Regent' 'models 8PE are priced at £128 10s. retail (slightly higher in the South Island), and are distributed throughout New Zealand by G. A. Wooller and Co., Ltd., Box 2167, Auckland.

NEW EVEREADY BATTERY



Of interest to radio and electrical dealers in particular, National Carbon, Pty., Ltd., announce the release of a new standard type battery No. X-71 (formerly a special, C-131) as a general utility $1\frac{1}{2}$-volt cell, wtih screw type terminals allowing for ease of coupling.

Overall dimensions are: Height, $4\frac{1}{4}$ in., by $1\frac{3}{8}$ in. square.

New Heating Cable

Introduced by Messrs. Pyrotenax, in sizes from 0.082 to 0.228 inches outer diameter, this special heating cable is a new and efficient form of radiant heating now available in New Zealand. The heart of this system is the cable itself, which consists of an inner conductor of "Kumaal" alloy which, having a relatively high resistance, permits a comparatively short length of cable to be connected directly to the power supply. This inner core is surrounded by an insulating layer of magnesium oxide, which has excellent electrical insulating properties, and at the same time permits a ready transfer of heat from the inner conductor. The whole cable is protected by an outer sheath of copper, which affords good protection against damage, and, being connected to earth, avoids the danger of electrical shock.

The practical methods of use and installation of this new Pyrotenax cable are almost numberless, and its advantages over ordinary non-insulated resistance wires will be obvious to all.

When designing new buildings requiring central heating, architects will find that the incorporation of wall panels of $\frac{3}{8}$ in. plaster containing Pyrotenax heating cables will enable considerable saving to be made in building estimates. As an alternative to wall installations, skirting board units have been designed to replace the ordinary base board and provide heat where required. In special cases of multi-storied buildings, where heat is required

(Continued overleaf.)

simultaneously in adjacent stories, Pyrotenax cable may be placed in the floors. Heating of existing buildings may be modernized by the mounting of cables at the top of the walls, and although this would slightly reduce convection effect, it would increase radiant efficiency.

Insulation could be provided at the rear of panels or grids to prevent heat losses when heat is required to be localized.

The economics of this new heating system cannot be over-emphasized. Saving is effected by low temperature radiant heating in many ways. For example:

1. The capital cost is considerably lower than that for any other accepted method of heating.
2. Operating costs are reduced as radiant heating, like the sun, does not raise the air temperature to anything like that of hot air systems. Consequently, thermal loss due to air changes is proportionately reduced.
3. Low temperature or radiant heating is actually more efficient than any other form of heating where the temperatures are high enough for air convection to take place.

In New Zealand already some interesting applications of the cable have been undertaken, such as the maintaining of oil pipelines at a suitable flow temperature, and similarly a chocolate pipeline. Stocking knitting machines have been raised to an efficient operating temperature, and chemical baths of various types have been kept at fixed temperatures. The system is also used extensively for greenhouse heating, apple ripening houses, chicken brooders, and concrete pile and part curing.

Further information will be supplied by the New Zealand distributors, Messrs. Giles and Elliott of Wellington.—P.B.A.

Proceedings of the New Zealand Electronics Institute Incorporated.

ANNUAL REPORT OF THE COUNCIL

The Council of the New Zealand Electronics Institute (Inc.) submitted the following Annual Report for the year ended 31st May, 1952.

Meetings

(a) *Annual Meeting*—The Annual Meeting provided for under Section 17 of the Constitution was held in Room 9A, Ground Floor, Air Department Building, Bunny Street, Wellington, on Thursday, 9th August, 1951.

(b) *Council Meetings*—Three Council meetings were held during the year as against seven for the previous year. It has been found difficult to obtain a quorum for Council meetings and a policy has now been adopted of endeavouring to arrange for meetings in centres other than Wellington. One of the meetings held during the year was held in Christchurch, and efforts were made to hold a meeting in Dunedin, but these were unsuccessful.

Membership

The current financial membership figures now total 128 as compared with 133 last year. Details were set out hereunder:—

	Overseas	Auckland	Christchurch	Dunedin	Wellington	Total
Members	0	1	2	0	6	9
Associate Members	2	1	7	7	18	35
Associates	1	8	16	12	18	55
Students	1	4	7	9	8	29
	4	14	32	28	50	128

Admissions Committee

All nominations for membership received were forwarded to and considered by the Admissions Committee.

Branches

(1) *Auckland*—Continuing efforts have been made to interest members and prospective members in Institute affairs in Auckland, but it has been most difficult to arouse any enthusiasm or co-ordinate the activities in that branch. Efforts will be made during the forthcoming year to form the nucleus of a strong committee from the 21 members at present resident in the Auckland Province, and it is hoped that the next Annual Report will reveal a different state of affairs in this important Province.

(2) *Christchurch*—Christchurch Branch is now firmly established and several meetings, operational displays and field days were held during the year under the chairmanship of Mr. R. G. Tulloch.

(3) *Dunedin*—Dunedin Branch, with an increased membership of two has maintained and further established Institute affairs in Otago. Regular meetings were held and Council representatives, Messrs. Shiel and Symmons in furthering the Institute objectives in Dunedin by means of these meetings are to be commended.

(4) *Wellington*—Mr. R. J. Dippy, chairman of the Wellington Branch reports a successful year in Wellington where meetings were arranged for 5.30 p.m. and following a light tea members either witnessed operational displays or listened to interesting talks. Wellington Branch has also established a library and it is pleasing also to record an increase in membership, again of two, in the capital city.

Finance

The financial statement is self-explanatory and reveals that Institute finances have been managed prudently during the year. It is hoped that the position will be strengthened during the forthcoming session and that funds available for development purposes will gradually increase.

Membership Certificates

As members are admitted certificates are prepared and issued in their name according to the status granted and all recipients are particularly asked to ensure that their

(Continued on next page.)

certificates when received are suitably framed and displayed.

Educational

It has not been possible to revise the examination syllabus during the year, hence examinations were not held. It is proposed to set up an Educational Sub-committee to investigate the position regarding the existing examination syllabus, with a view to revising it and thus arranging for candidates to sit during the forthcoming year.

Prize Awards

A prize award for the highest marks gained in the Radio Servicemen's written examination during September, 1951, was granted to Mr. Reginald Le Fleming Green, who obtained a mark of 49 out of a possible 50. The Council would congratulate this candidate on such a meritorious achievement.

Official Organ

Proceedings of the Institute, covering activities in the Branches and other general news have appeared in *Radio and Electronics* each month, and members have received their copies regularly.

Institute Insignia

The official emblem for the Institute is now appearing on all official papers, stationery, etc., issued from headquarters and branches.

Brochure

During the year copies of the Institute brochure were distributed to prospective members throughout the Dominion and several inquiries were received, in addition to which many members have been enrolled.

Thanks

Your Council, on behalf of Institute members, extends its thanks to:

(1) The proprietors of *Radio and Electronics,* who kindly grant the Institute free space each month for publication of its Proceedings.

(2) Executive officers and Branch Committees and other members who have actively supported Institute activities during the past year.

(3) Those individuals who give of their time to deliver addresses and displays of operational equipment, for the benefit of those attending Institute functions.

(4) Philips Electrical Industries of New Zealand Limited for continued donations of technical literature to add to the Institute Library.

(5) Those trading organizations who so generously give donations of funds to the Institute.

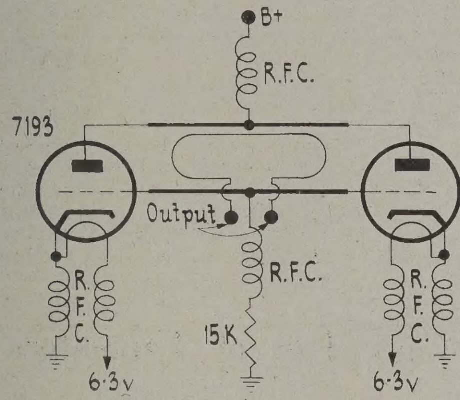
(6) All other individuals and firms who directly or indirectly contributed to the success of the past year.

Looking to the future, if the Institute is to take its rightful place in the electronics industry it would seem that all members must support their Branch Commit-

tees and endeavour to interest others, in order that the Electronics Institute here in New Zealand may develop on similar lines to the very sound educational electronics organizations so firmly established in Great Britain.

For and on behalf of the Council,
W. L. HARRISON, *President.*

A 144 Mc/sec. Oscillator for 7193s



Not very much has appeared about the 7193 valves which are available very cheaply on the surplus market, apart from a description of their characteristics, which was printed in our "Tube Data" section in the March, 1951, issue. Briefly, this valve is nothing but a 6J5G, with its plate and grid connections brought out to caps on top of the bulb instead of to the base pins. This construction makes the tube useful at quite high frequencies, and when a low-powered oscillator was needed in our laboratory for some experimental work, it was thought that a pair of these tubes, in a push-pull line-tuned oscillator circuit, would fill the bill quite nicely. The oscillator that was built was so successful that we decided to print a brief description of it for the benefit of those who are interested in a low-powered oscillator for the 2-metre amateur band.

The circuit could hardly be simpler, and consists of a shortened half-wave line, with a valve connected at each end. It is really a double Colpitts oscillator, and so we find the cathodes isolated from ground by R.F. chokes. In order to render harmless the capacity between the cathode and heater of the valves, the former is tied to one side of the heater, and an R.F. choke is inserted in the "hot" heater lead, too. The line consists of a pair of 14-gauge copper wires spaced $\frac{3}{4}$ in. apart. The line is 16 in. long, so that the oscillator would take up quite a bit of room, but for the fact that the wires are bent round in the form of a C. The valves are mounted horizontally, with the plate connecters uppermost, and they are placed so as to occupy the open part of the C-shaped line. This brings the two valve sockets quite close together, and makes it easier to provide suitable earth points. The whole thing is mounted on a rectangular breadboard, and solder lugs for the filament and H.T. connections are screwed to the board midway between the open ends of the line. The filament and cathode chokes are then run, self-supporting fashion, from these lugs to the valve sockets, which are mounted vertically on small aluminium brackets. The output loop is made from 16-gauge copper wire, mounted as shown in the diagram, opposite the centre of the line. Two solder lugs screwed to the front edge of the board serve to mount the loop. This can couple to the aerial line directly, or can be tuned by a 3–30 $\mu\mu$f. Philips trimmer, connected across the output terminals. If the loop is tuned, it will be found that the coupling can be much looser than if it is untuned. Should trouble be experienced with the oscillator squegging, this indicates too tight coupling between the output loop and the line. The power output is approximately four watts, which is plenty to put a healthy signal into a 2-metre beam.

R1155 Conversion

(Continued from Page 5.)

use a 6X5. The valves in the receiver need 2 amps for their heaters. Transformers with only a 6.3 volt winding have it rated at 3 amps. Those with a 5v. rectifier winding have both this and the 6.3v. winding rated at 2 amps.

In conclusion, let us point out that the whole job is not nearly as fearsome as this account might lead one to expect. Indeed it need not take more than a couple of evenings' work to do the whole thing, and the convenience of having a self-contained receiver is well worth the trouble. The set is a sensitive and selective one, well capable of out-performing many more pretentious, but less solidly constructed receivers. The one we had in our laboratory showed signs of long storage, but for all that it needed only the slightest tweak on the R.F. and aerial trimmers to be performing right on the top line.

Co-Axial Wavemeter

(Continued from Page 11.)

$3\frac{1}{8}$ in. long. Of this, half an inch was taken up by the part of the shorting plug that projected inside, so that the actual co-axial part of the line was $2\frac{5}{8}$ in. long, as stated above. The length of the inner is adjusted so that it projects a quarter of an inch from the end of the inner conductor. This enables the clip, which is made to connect the inner to the stator plates of the condenser, to be mounted some 3/16 in. away from the end of the outer, thus reducing its capacity. The connection from the inner that comes through for the diode plate, is made half an inch from the end of the line. That is, half an inch from the actual short-circuit, whether a plug or a plate is used to close the end of the outer conductor.

USE OF A CRYSTAL DIODE

The instrument would be slightly more convenient if it did not have to have connections made for the heater of the diode, and the job is one that really calls for a silicon crystal diode. Unfortunately, these are not generally available here, and so use was made of the EA50 diode, which is. Alternatively, a war surplus equivalent of the EA50 may be used. This is the VR78, which is identical with the EA50 except for a four-volt filament instead of the EA50's 6.3 volt one.

Germanium crystal diodes are not very satisfactory for this purpose, because their performance starts to fall off after about 150 mc/sec., and is well down by the time 420 mc/sec. is reached. However, if a silicon crystal can be obtained, there is no reason why it should not be used, the circuit remaining identical except for the absence of the heater leads.

Tube Data

(Continued from Page 15.)

needed, although this gain is at the expense of a requirement for higher amplification in the I.F. amplifier; (c) no A.F. amplifier stage is needed apart from the power amplifier; (d) the output voltage of the EQ80 is large enough to enable substantial negative feedback to be applied to the output stage, even when there is no intermediate audio amplifier.

Philips Experimenter

(Continued from Page 25.)

account of itself, if not an amazing one. With the circuit constants used, the selectivity performance was as follows:—

Control at Maximum Selectivity

Bandwidth	Attenuation.
146 c/sec.	3 db.
222 c/sec.	6 db.
800 c/sec.	20 db.
Bandwidth	Attenuation.
2000 c/sec.	3 db.
2700 c/sec.	6 db.
6100 c/sec.	20 db.

At the centre frequency of 455 kc/sec., at which the circuit was aligned, the bandwidth obtained in the maximum selectivity position corresponds to a circuit Q of no less than 3100, and when it is considered that this was obtained with complete operational stability, the remarkable properties of the circuit are fairly obvious.

(To be continued.)

Proper Use of Capacitors

(Continued from Page 21.)

inductance of its wire leads to obtain the theoretically zero impedance of a series resonant LC circuit.

The self inductance of certain types of windings can be used and capacitors made which will have self resonant characteristics at any frequency. Such capacitors have been used in I.F. by-pass circuits of A.M. receivers to trap I.F. voltages.

The self-resonances of the capacitor may be found by connecting the ends of the leads together and measuring the frequency at which this L-C combination produces a response on a grid-dip meter or other absorption indicating device. The exact length of the wire lead to be used in the circuit must be used in this measurement for precise results. This is illustrated by the fact that the resonant frequency of a tubular .01 μf. unit having leads of 20-gauge wire $\frac{1}{2}$ in. long is about 11 mc/sec. However, if the leads are trimmed to $\frac{1}{8}$-inch, the self-resonance is raised to about 40 mc/sec.

For capacitor types which do not have flexible lead wires, the terminals may be connected by a wire of known or calculated inductance and then corrected for this added inductance to find the true resonance.

Dual by-passing is frequently used where effective by-passing must be provided over a wide band of frequencies. A small, low inductance unit for R.F. is connected in parallel with a large condenser of poor quality for audio frequencies. The high capacitance unit, if used alone, would contain too much residual inductance to be effective for R.F. and economy prevents the use of a mica or other high quality condenser of sufficient capacity to by-pass all frequencies.